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ABSTRACT

Designed to be a tool for curriculum and instructional development consistent with assessment of the state objectives in mathematics, this teaching and testing guide provides a summary of the skills that should be considered instructionally and how each objective is tested. Information is included on state objectives for mathematics teachers for grades 7 and 8. General information which applies to all grades or particular grade ranges and specific by-grade information is provided within each of the five state mathematics objectives: (1) concepts, (2) operations, (3) measurement, (4) geometry, and (5) problem solving. For each objective, instructional activities are suggested for helping the student learn the basic skills. The reading levels of the tests for each grade are presented in tabular form. A cumulative mathematics word list is included. Procedures and examples are offered for writing test items. (Author/PN)

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Mathematics
Grades 7 and 8

Teaching and Testing
Our Basic Skills Objectives

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Basic Skills Assessment Program
South Carolina Department of Education

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BASIC SKILLS ASSESSMENT PROGRAM

This guide is the first in the Mathematics T & T Series (yellow).

T & T, Grades 1, 2, 3

T & T, Grades 4, 5, 6

T & T, Grades 7 and 8

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TEACHING AND TESTING
OUR BASIC SKILLS OBJECTIVES
(T & T)

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Introduction

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HOW TO USE T & T

AREA: Mathematics GRADE: All

Purpose

As a result of the Basic Skills Assessment Program (BSAP), a substantial contribution to education in South Carolina will be that of instructional improvement. The purpose of T & T is to provide educators - primarily, local level administrators and teachers - with a tool for curriculum and instructional development which complements the assessment of the State Objectives in Mathematics. T & T provides a summary of the skills that should be considered instructionally and how each objective is tested.

The intent of this guide is not to limit the curriculum but rather to focus on that part of the curriculum which is reflected in the State Basic Skills Objectives. Although the actual BSAP testing is limited to Grades 1, 2, 3, 6, 8, and 11, this guide also contains information on the State Mathematics Objectives for use by teachers for the grades not tested - Grades 4, 5, 7, 9, 10, and 12.

The State Kindergarten Objectives are not included in T & T. However, this in no way detracts from their instructional significance for kindergarteners and for primary grade students. The 18 Kindergarten Objectives are the primary components of a strong readiness program aimed at fundamental skills necessary to future success in Reading, Writing, and Mathematics.

Color-Coding

Following the Introduction, there is one color-coded section for each of the five State Mathematics Objectives.

Introduction (white)

Concepts (yellow)

Operations (white)

Measurement (yellow)

Geometry (white)

Problem Solving (yellow)

Organization

Introduction

Introductory information pertinent to all grades is contained in this section of T & T. This information is duplicated in each T & T grade level booklet.

Objective Sections

Two types of information are provided within each color-coded objective section: (1) general information which applies to all grades or particular grade ranges and (2) specific by-grade information.

Information for All Grades

Information which applies to all grades (GRADE: All) or a particular grade range (GRADE: Early, Later, 1-3, 4-6, or 7 & 8) is provided first.

Information labeled "GRADE: All, Early, or Later" is duplicated in each T & T Mathematics booklet. Other information labeled "Grade: 1-3, 4-6, or 7 & 8", may or may not be duplicated in each T & T Mathematics booklet. This information includes the following topics.

- "TEACHING OUR SKILLS"
  - "WHAT SKILLS OUGHT TO BE CONSIDERED"
  - "WHAT ARE SOME IDEAS FOR ACTIVITIES"
- "TESTING OUR SKILLS"
  - "HOW SKILLS ARE TESTED"
  - "SKILL DIFFICULTY CHART"

Information by Grade Level

Information which applies to a particular grade level (GRADE: 1 or 2 or 3 or 4 or 5 ...) is provided next. This information is not duplicated in each T & T Mathematics booklet and includes the following topics.

- "TEACHING OUR SKILLS"
  - "WHAT SKILLS OUGHT TO BE CONSIDERED"
- "TESTING OUR SKILLS"
  - "HOW SKILLS ARE TESTED"

Pagination

Each page number is made up of three components: (1) the area or objective abbreviation is first, (2) the grade symbol follows the hyphen, and (3) the page sequence number follows the decimal point. For example, CN-0.4 is read as follows: Concepts, information for all grades, page 4. The letter a is used to denote the back of a page. Therefore, CN-0.4a would be the page number on the back of page CN-0.4. Other examples using the abbreviations and symbols follow.

Example	Area/Objective
M-0.1	M = Introduction (Mathematics)
CN-7.1	CN = Concepts
OP-7.1	OP = Operations
ME-7.1	ME = Measurement
GE-8.1	GE = Geometry
PS-8.1	PS = Problem Solving

Grade Level

0 = Information for all grades or a range of grades (i.e., EARLY, LATER, 1-3, 4-6, or 7 & 8)

7 = Information for 7th grade

8 = Information for 8th grade

For the T & T Mathematics series, the pages, regardless of the page number and grade range of the booklet, contain the same information, except for those page numbers that are asterisked (*). The page references on these asterisked pages change depending on the grade range of the T & T booklet.

Important Features of T & T

Subskills

For each objective, the subskills that were identified for testing are given. Like the objectives, these skills repeat at each grade; however, all subskills may not be tested at every grade.

A chart which gives an overview across grades is provided (for example, refer to page CN-0.2). The following symbols are used.

O - Open circles indicate that the skill is not tested on the Basic Skills Tests, but, nevertheless, should be considered instructionally.

● - Solid circles indicate that the skill is tested on the Basic Skills Tests and should be considered instructionally.

Blank - No circles indicates that the skill may not be appropriate for that grade.

The same information in the chart is duplicated in the corresponding grade level section for the given objective (for example, refer to page CN-8.1).

Other Important Skills

In addition to the subskills, there are other skills that are instructionally important which are not directly tested on the Basic Skills Tests.

A chart which provides an overview of the instructional placement across grades is provided (for example, refer to page CN-0.2a).

O - Open circles indicate that the skill is not tested on the Basic Skills Tests but, nevertheless, should be considered instructionally.

Blank - No circle indicates that the skill may not be appropriate for that grade.

The same information in the chart is duplicated in the corresponding grade level section for the given objective (for example, refer to page CN-8.1a).

Activities

For each objective, instructional activities are suggested for helping the student learn the basic skills. Many of the early grade activities (GRADE: Early), although elementary in nature, may provide you with ideas for activities for older students. Similarly, many of the later grade activities (GRADE: Later) can be adapted for use with younger students.

Teachers are encouraged to use other resources, as well as their own ideas, in coming up with other activities. A page is included for teachers to make note of references to other resource materials (for example, refer to page CN-0.3).

Test Item Description: Overview

For each objective, a general overview of the test item is provided (for example, refer to page CN-0.12). The overview provides the rationale behind the development of test items for all grades. Reading this information is crucial to your understanding of how the objective is tested.

Skill Difficulty Chart

There is one Skill Difficulty Chart for each objective. This chart illustrates the instructional continuum which serves as the basis for testing. These charts should provide local administrators and teachers with guidance in planning their instructional programs for basic skills.

The content of the Skill Difficulty Chart for each objective is not exhaustive. Therefore, teachers at all grade levels are encouraged to refer to the Suggested Measurement Strategy accompanying each State Objective.

A description of the chart follows (for example, refer to page CN-0.13).

OBJ./SUB. - In the far left column, the objective (OBJ.) or Subskills (SUB.) tested are listed. In this column, information that applies to all subskills is provided first and is labeled "ALL SUBSKILLS". Information that is specific to particular subskills is provided next and is labeled with the subskill name (for example, Counting).

SKILL KEYS - In the next column over, the controls used in developing test items are given (for example, NATURE OF PROBLEM). These controls were used to increase the difficulty of the test items across grades.

CHART ENTRIES - In the chart entries for each grade, instructionally relevant information about the SKILL KEYS is provided.

For those grades that do not take the Basic Skills Tests, the chart entries are left blank for you to complete by consulting the Suggested Measurement Strategy for the State Objective.

Content Supplements

These supplements, where pertinent, follow the Skill Difficulty Charts (for example, refer to page ME-0.13). In these sections, the content eligible for testing a specific subskill at each grade is detailed. For those supplements designated as cumulative, the content at earlier grades applies to subsequent grades and should be considered instructionally.

Sample Test Items and Directions

Samples of the types of test items on the Basic Skills Tests are given by grade for each objective (for example, refer to pages CN-8.2 to CN-8.5). These sample test items, with their directions, can serve as a guide in classroom assessment of basic skills instruction. The "Directions" indicate how the test item is administered. The following terms are used with the "Directions".

1. "Teacher reads." - The information is read by the teacher from the *Teacher's Administration Manual*.
2. "Student reads." - The information is read by the student from the test booklet.
3. "Teacher/Student read." - The information appears in both the *Teacher's Administration Manual* and test booklet. The teacher reads the information while the student follows and reads silently.

Write Your Own Item

For each sample test item, there is space for you to write your own item. Pages can be added if you write more items. Share them with other teachers. When you write your items, make sure your items at least meet the criteria in the Skill Difficulty Charts. In "How to Write Your Own Items" at the end of this section, illustrations and specific directions on how to write your own items are given.

WHAT IS THE READING LEVEL OF THE TESTS

AREA: Mathematics GRADE: All

The criteria in this chart apply to the Basic Skills Tests for all State Mathematics Objectives in which selections and/or directions are read by the student.

MATHEMATICS PROBLEMS

READING CONTROLS	GRADE 1	GRADE 2	GRADE 3	GRADE 6	GRADE 8	GRADE 11
PROBLEM LENGTH	24 words maximum	24 words maximum	30 words maximum	40 words maximum	50 words maximum	75 words maximum
NUMBER OF SENTENCES	3 sentences	4 sentences maximum	4 sentences maximum	No limits	No limits	No limits
SENTENCE LENGTH	8 words maximum	8 words maximum	10 words maximum	14 words maximum	16 words maximum	20 words maximum
SENTENCE STRUCTURE	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
VOCABULARY DIFFICULTY*	S. C. Word List, Grade 1 Mathematics Word List, Grade 1	S. C. Word List, Grade 1 Mathematics Word List, Grade 2 or below	S. C. Word List, Grade 2 or below Mathematics Word List, Grade 3 or below	S. C. Word List, Grade 4 or below Mathematics Word List, Grade 6 or below	S. C. Word List, Grade 6 or below Mathematics Word List, Grade 8 or below	S. C. Word List, Grade 9 or below Mathematics Word List, Grade 11 or below

*Refer to the publication the South Carolina Word List and to the Mathematics Word List in T & T.

HOW TO USE THE MATHEMATICS WORD LIST

AREA: Mathematics GRADE: All

Purpose of Word List

The Mathematics Word List is a supplement to the South Carolina Word List. The words included on the Mathematics Word List which follows are vocabulary words which may appear in the mathematics test items at each grade.

The list is not intended to be comprehensive. Other important mathematics vocabulary words (e.g., add, factor, quotient, etc.) are not on this list. Teachers should add other important words to the list.

The list is cumulative; therefore, students at each grade should know words for all previous grades.

MATHEMATICS WORD LIST

AREA: Mathematics

GRADE: 1-3

This list is cumulative; therefore, students at each grade should know words for all previous grades.

Grade 1

altogether
answer
below
between
bubble
circle
clock
closed
coin
count
curve
darken
days of the week
digit
fall
heavy
hot
hour
largest
left
mark
month
names of months in a year
nickel
number
objects
open
penny
place
problem
quarter
rectangle
same
seasons of the year
shape
smallest
spring
square
summer
tall
temperature
tens
triangle
use
warm
weigh
week
winter
word names of numbers 1-10
worth

Grade 2

centigrade
centimeter(s)
cold
cup(s)
dollar
Farenheit
fifth
figure
first
fourth
half-dollar
inch(es)
kilogram(s)
least
missing
most
o'clock
pair
pound(s)
sentence
second(s)
shaded
shown
size
tells
third
thermometer
true
unit
warm
wide
word names of numbers 10-399

Grade 3

angle
costs
dotted
exactly
folded
gallon
inside
line
meter
millimeter(s)
outside
pint(s)
point
quart(s)
ray
right
segment
word names of numbers 400-999
yard

MATHEMATICS WORD LIST

AREA: Mathematics

GRADE: 4-6

This list is cumulative; therefore, students at each grade should know words for all previous grades.

Grade 4

(Grade 3 words and other appropriate words)

Grade 5

(Grades 1-4 words and other appropriate words)

Grade 6

- area
- average
- center
- circumference
- cone
- congruent
- cube
- cylinder
- diagonal
- diameter
- equilateral
- equal
- estimate
- gram(s)
- hundredth(s)
- intersecting
- intersection
- isosceles
- kilogram(s)
- kilometer(s)
- liter(s)
- metric ton
- midpoint
- milliliter(s)
- parallel
- parallelogram
- perimeter
- perpendicular
- polygon
- radius
- ray
- rhombus
- scalene
- sphere
- tenths
- thousand(s)
- vertex
- volume

MATHEMATICS WORD LIST

AREA: Mathematics

GRADE: 7 & 8

This list is cumulative; therefore, students at each grade should know words for all previous grades.

Grade 7

(Grades 1-6 words
and other
appropriate words)

Grade 8

acute
approximate
average
bisector
construction(s)
coordinate
grid
hexagon
obtuse
pentagon
quadrilateral
rectangular
prism
scalene
similar
solid
straight
trapezoid

HOW TO WRITE YOUR OWN ITEMS

AREA: Mathematics GRADE: All

Procedure

An emphasis has been placed on multiple-choice items in T & T because these types of items are the ones used in the Basic Skills Tests. Well-constructed fill-in-the-blank items are as necessary to the mathematics teacher as are multiple-choice items. Perhaps more important than the type of item, whether multiple-choice, fill-in-the-blank, or true-false is the quality of the item. Multiple-choice or other types of items can reflect trivial or off-target responses. Moreover, any type of item can be constructed to reflect basic skills objectives at the appropriate level of difficulty.

Although the sample items are multiple-choice, the first step toward constructing a multiple-choice item may involve the use of fill-in-the-blank items.

The following procedure may be used for writing your own test items.

1. Write fill-in-the blank questions for an objective.
2. Try out the questions on the students in your class to get information for incorrect answer choices.
3. Score the items.
4. Correct any flaws in your test questions.
5. Use the most appropriate incorrect responses as answer choices.
6. Use any information on correct responses in your instruction.
7. Put the items in multiple-choice format and administer them again as a posttest or during the next year.

To practice the item writing process, administer one of the sample items to the appropriate students as fill-in-the-blank items. Then, compare the incorrect student responses to the incorrect responses given with the sample item. After you review your student responses and study how to use T & T, try writing your own items for the grade that you teach.

Annotated Sample Items

On the following pages, sample items for Problem Solving are presented for Grades 1, 2, 3, 6, and 8. The sample item is presented in the left column and information on how to use T & T to write the test items is provided in the right column.

The sample items have been purposefully constructed to illustrate how the test items build on one another as grade levels increase. These items and their annotations should provide you with models on writing your own items for other objectives and subskills. The readability chart on Page M-0.5, the Skill Difficulty Chart SKILL KEYS, and the sample test items for each objective contain the information necessary for writing your own test items.

As an exercise, examine the Skill Difficulty Chart for Problem Solving and determine the key difficulty elements that change from grade to grade and concurrently examine the annotated sample items. Try this for all objectives and subskills.

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 1

Sample Item, Grade 1	Writing Items with T & T
John has 4¢. He gets 1¢ more. How much money does John have now? (over)	Word Problem Note: Refer to the chart on page M-0. 5, the Skill Difficulty Chart SKILL KEYS on page PS-0.11, and the sample items for this objective. PROBLEM TYPE: Arithmetic READABILITY: Total words 24 or less, 3 sentences, up to 8 words per sentence, Grade 1 vocabulary (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text only UNNECESSARY DATA: Not allowed TYPES OF NUMBERS: Whole numbers NUMBER OF OPERATIONS: Only one allowed TYPES OF OPERATIONS REQUIRED: Addition or subtraction (Addition needed for this item) OPERATION DIFFICULTY: No regrouping allowed TYPE OF PROBLEM SOLUTION: Exact (over)

OBJECTIVE: Problem Solving GRADE: 1

Sample Item, Grade 1	Writing Items with T & T
3¢ ○ 4¢ ○ 5¢ ●	Answer Choices Incorrect responses should all represent typical errors students might make, for example, errors in data selection, selection of operations, or computation. 3¢ - Wrong Operation: Subtracted 4¢ - 1¢ = 3¢ 4¢ - Data Selection Error: Selected one piece of data 4¢ as answer 5¢ - Correct: 4¢ + 1¢ = 5¢

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 2

Sample Item, Grade 2	Writing Items with T & T
John had 14¢. He gets 3¢ from his mother. How much money does John have now? (over)	Word Problem Note: Refer to the chart on page M-0. 5, the Skill Difficulty Chart SKILL KEYS on page PS-0.11, and the sample items for this objective. PROBLEM TYPE: Arithmetic READABILITY: Total words 24 or less, up to 4 sentences, up to 8 words per sentence, Grade 1 vocabulary (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text only UNNECESSARY DATA: Not allowed TYPES OF NUMBERS: Whole numbers NUMBER OF OPERATIONS: Only one allowed TYPES OF OPERATIONS REQUIRED: Addition or subtraction (Addition needed for this item) OPERATION DIFFICULTY: No regrouping TYPE OF PROBLEM SOLUTION: Exact (over)

OBJECTIVE: Problem Solving GRADE: 2

Sample Item, Grade 2	Writing Items with T & T
11¢ 14¢ 17¢ ○ ○ ●	Answer Choices Incorrect responses should all represent typical errors students might make, for example, errors in data selection, selection of operations, computation, or sequence of operations. 11¢ - Wrong Operation: Subtracted 14¢ - 3¢ = 11¢ 14¢ - Data Selection Error: Used one piece of data 14¢ as the answer 17¢ - Correct: 14¢ + 3¢ = 17¢

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 3

Sample Item, Grade 3	Writing Items with T & T
John has 14¢ in his bank. He finds another 5¢ in a chair. John buys a 15¢ candy bar. How much money does John have now? (over)	Word Problem Note: Refer to the chart on page M-0. 5, the Skill Difficulty Chart SKILL KEYS on page PS-0.11, and the sample items for this objective. PROBLEM TYPE: Arithmetic READABILITY: Total words 30 or less, no more than 4 sentences, up to 10 words per sentence, Grade 2 vocabulary or below (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text UNNECESSARY DATA: Allowed, but not necessary (None in this item) TYPES OF NUMBERS: Whole numbers NUMBER OF OPERATIONS: 1 or 2 (2 for this item) TYPES OF OPERATIONS REQUIRED: Addition, subtraction, or multiplication (Addition and subtraction needed for this item) OPERATION DIFFICULTY: Regrouping, direct conversions TYPE OF PROBLEM SOLUTION: Exact (over)

OBJECTIVE: Problem Solving GRADE: 3

Sample Item, Grade 3	Writing Items with T & T
4¢ ● 5¢ ○ 19¢ ○	**Answer Choices** Incorrect responses should all represent typical errors students might make, for example, errors in data selection, selection of operations, computation, or sequence of operations. 4¢ - Correct: 14¢ + 5¢ = 19¢ 19¢ - 15¢ = 4¢ 5¢ - Data Selection Problem: Used only one piece of data 5¢ as answer 19¢ - Data Selection Problem: Performed only the addition operation, 14¢ + 5¢ = 19¢

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 4-6

Sample Item, Grade 6	Writing Items with T & T
John likes to play racket ball. A racket ball court rents for \$1.50 per hour. John has \$1.50 and his friend has \$6.00. If each pays the same amount, what is the longest time they can play together? (over)	Word Problem Note: Refer to the chart on page M-0.5, the Skill Difficulty Chart SKILL KEYS on page PS-0.11, and the sample items for this objective. PROBLEM TYPE: Arithmetic, measurement, and/or geometry (Arithmetic for this item) READABILITY: Total words 40 or less, up to 14 words per sentence, Grade 4 vocabulary or below (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text (may be accompanied by pictorial display) UNNECESSARY DATA: Allowed (None present in this item) TYPES OF NUMBERS: Whole numbers, fractions, mixed numbers, decimals (Decimals used in this item) NUMBER OF OPERATIONS: up to 3 (2 may be required for this item) TYPES OF OPERATIONS REQUIRED: Addition, subtraction, multiplication, and/or division (Addition and division may be required for this item) (over)

OBJECTIVE: Problem Solving GRADE: 4-6

Sample Item, Grade 6	Writing Items with T & T
	Word Problem (continued) OPERATION DIFFICULTY: Regrouping, reduction of fractions, measurement conversions (Regrouping may be required for this item) TYPE OF PROBLEM SOLUTION: Exact or estimated (Exact for this item) Answer Choices Incorrect responses should all represent typical errors students might make, for example, data selection errors, operational errors, arithmetic errors, errors in unit selection, or estimation errors
(A) 1 hr.	1 hr. - Data Selection Error: Considered John's money only, per hour cost, \$1.50 ÷ \$1.50 = 1 hr.
(B) 2 hrs.*	2 hrs. - Correct: John has only \$1.50 and his friend has at least \$1.50, therefore, can play for 2 hours; \$1.50 + \$1.50 = \$3.00, \$3.00 ÷ \$1.50 = 2 hrs.
(C) 4 hrs.	4 hrs. - Data Selection Error: Considered friend's money only, \$6.00 ÷ \$1.50 = 4 hrs.
(D) 5 hrs.	5 hrs. - Data Selection Error: Considered total of John and friend's money, forgot about same amount qualifier, \$7.50 ÷ \$1.50 = 5 hrs.

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 7 & 8

Sample Item, Grade 8

Tennis Sale

Rackets (frame only)	
Borg	$75.00
Davis	$26.95
Wilson	$22.00
Yamaha	$55.00
Balls (can of 3)	$ 2.00 per can
Shorts	$10.50 per pair
Shirts	$12.25 each
Strings:	
Blue Star	$15.00
Gut	$26.00

John has $100.00 to spend on new tennis equipment. With his money, he buys 2 cans of balls, 1 pair of shorts, and 1 shirt. John wants to buy a new racket with Gut Strings. What is the most expensive racket frame he can buy with the money he has left?

(over)

Writing Items with T & T

Word Problem

Note: Refer to the chart on page M-O.5, the Skill Difficulty Chart SKILL KEYS on page PS-O.11, and the sample items for this objective.

PROBLEM TYPE: Arithmetic, measurement, and/or geometry

READABILITY: Total words 50 or less, up to 16 words per sentence, Grade 6 vocabulary or below (see S. C. Word List)

METHOD OF OBTAINING DATA: Verbal text, may require interpretation of graphic information

UNNECESSARY DATA: Allowed (Some present in this item)

TYPES OF NUMBERS: Whole numbers, fractions, mixed numbers, decimals, percentages (Decimals and whole numbers used in this item)

NUMBER OF OPERATIONS: Up to 3 (2 or 3 may be needed for this item)

TYPES OF OPERATIONS REQUIRED: Addition, subtraction, multiplication, and/or division (Addition, subtraction, and multiplication may be required for this item)

(over)

OBJECTIVE: Problem Solving GRADE: 7 & 8

Sample Item, Grade 8	Writing Items with T & T
	Word Problem (continued) OPERATION DIFFICULTY: Regrouping, reduction of fractions, measurement conversions (Regrouping may be required for this item) TYPE OF SOLUTION: Exact or estimated (Exact for this item) Answer Choices Incorrect responses should all represent typical errors students might make, for example, data selection errors, operational errors, arithmetic errors, errors in unit selection, or estimation errors.
(A) Borg	Borg - Data Selection Error: Only considered price of racket
(B) Davis*	Davis - Correct: $10.50 + $12.25 + $2.00 + $2.00 + $26.00 = $52.75; $100.00 - $52.75 = $47.25
(C) Wilson	Wilson - Question Error: Chose least expensive racket
(D) Yamaha	Yamaha - Data Selection Error: $10.50 + $12.25 + $2.00 + $2.00 = $26.75 (omitted Gut Strings); $100.00 - $26.75 = $73.25

Concepts

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TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Concepts GRADE: All

Objective

The student can apply numerical concepts.

Explanation

The Concepts objective promotes numerical understanding and skills that are prerequisite for mastery of other mathematics objectives. The objective includes a broad body of content from counting and determining place value to identifying numerical equivalencies and establishing numerical relationships. Tables and graphs complete the content range. The ability to interpret pictorial representations of numerical data also requires conceptual skills.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Counting The student can count.	●	●	●	O								
2. Identifying Equivalencies The student can identify equivalent ways of expressing the same numerical quantity.	●	●	●	O	O	●	O	●	O	O	●	O
3. Establishing Relationships The student can establish relationships between numerical equalities.	●	●	●	O	O	●	O	●	O	O	●	O
4. Determining Place Value The student can determine the place value of numerical qualities.	●	●	●	O	O	●	O	●	O	O	●	O
5. Interpreting Tables and Graphs The student can extract and interpret information from tables and graphs.	O	●	●	O	O	●	O	●	O	O	●	O
6. Recognizing Square Roots The student can recognize common square roots.									O	O	●	O
7. Using Formulas The student can apply formulas.									O	O	●	O

OBJECTIVE: Concepts GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Comprehension of Numerical Representations The student can interpret the numerical representations for whole numbers, fractions, decimals, and percents. For example, given the numerical representation "$\frac{2}{3}$", the student associates that symbol with the concept "two-thirds."	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Mathematical Terminology The student understands the following types of mathematical vocabulary: (1) the word forms for whole numbers, fractions, and decimals; (2) names referring to place value (for example, "hundredths place"); (3) relationship words (for example, "most," "least"); (4) sequencing words (for example, "before," "next"); and (5) phrases requiring the determination of a quantity (for example, "how much," "how many," "what part").	O	O	O	O	O	O	O	O	O	O	O	O
3. Comprehension of Mathematical Symbols The student understands the following types of symbols: (1) operational signs (for example, +, -, x, and ÷); (2) relations symbols (for example, =, <, and >); and (3) symbols used in conjunction with numbers (for example, decimal point, percentage sign, and exponent).	O	O	O	O	O	O	O	O	O	O	O	O
4. Comprehension of Numerical Sequence The student understands that numbers can be: (1) arranged in ascending or descending order; (2) grouped by multiples; and (3) counted forwards or backwards.	O	O	O	O	O	O	O	O	O	O	O	O
5. Comprehension of Graphic Representations The student understands that numerical quantities and data relationships can be represented either visually (that is, in picture, circle, and bar graphs) or through a coordinate system of rows and columns (for example, in tables).	O	O	O	O	O	O	O	O	O	O	O	O

WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Concepts GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Counting	
2. Identifying Equivalencies	
3. Establishing Relationships	
4. Determining Place Value	
5. Interpreting Tables and Graphs	
6. Recognizing Square Roots	
7. Using Formulas	

ACTIVITY: Counting Time **GRADE:** Early

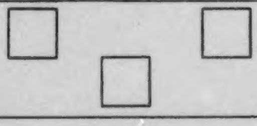
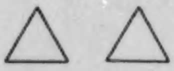
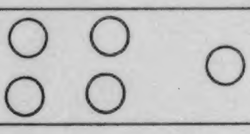
Purpose: To provide practice in the skills associated with counting and establishing number sequences

Materials: Blank Sheets of Paper and Chalkboard

Directions:

1. Distribute blank sheets of paper. Write a numeral on the chalkboard. Ask students to copy the numeral on their papers and then draw a set of objects equal in number. Let students exchange their papers and check each other's work.

2. Have students complete exercises such as the following, either at the chalkboard or on duplicated practice sheets.

ONE LESS	SET	ONE MORE
		
		
		

After students have completed such a chart, have them print the numeral that corresponds to each group of objects next to that group.

3. Have students arrange objects according to your oral directions. For example, "Put an eraser first, a pencil second, a crayon third, and a ruler fourth." After the objects are placed in order, ask students to hold up a particular object; for example, "hold up the third thing." Students can take turns giving the directionsto the class.

4. Assign each child a counting number. When it is time to have the class line up (for example, for recess or dismissal), or to divide into groups (for example, for a game), have students arrange themselves according to your directions. Base these directions on the assigned numbers. Students might line up in order from the smallest to the largest number or vice versa. Students might split into two groups according to even and odd numbers. Or students might form several groups by "counting off" using different multiples.

5. Prepare slips of paper based on a sequence of numbers. Each slip should have a different number on it. Write the word "least" at one end of the chalkboard and the word "greatest" at the other end. Students are to pick a slip of paper and position themselves in front of the board, according to the number drawn. The first student stands where he or she thinks is appropriate. Subsequent students arrange themselves around this student to form a line with their numbers in the sequential order shown on the board. At first this activity might be conducted with a simple sequence of numbers (counting by ones, for example). As students become more proficient at ordering themselves, more complex sequences might be employed.

CN-0.5

ACTIVITY: Block Busters **GRADE:** Early

Purpose: To promote learning of numerical equalities and inequalities and to provide understanding of mathematical symbols and terminology

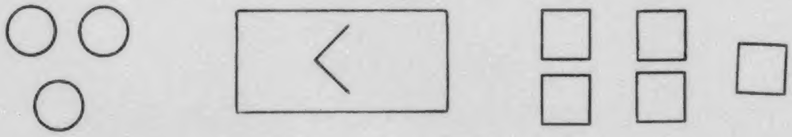
Materials: A Set of 10-30 Similar Objects, Index Cards, Chalkboard

Make or obtain a set of 10-30 similar objects (for example, blocks, cardboard counters, cut-out drawings).

Directions:

1. Distribute a set of the 10-30 similar objects to each student.
2. Have each student prepare index cards with a single mathematical symbol printed on each one. These symbols might include +, -, =, <, and > .
3. Have students arrange the objects on their desks so that the index card symbol is between two groups of objectives.

   Example:



4. Have students write the mathematical expression that corresponds to each arrangement on the chalkboard and then compare the expressions that resulted.

ACTIVITY: How Many Ways? GRADE: Early

Purpose: To promote students' skill with identifying numerical equivalencies

Materials: None

Directions:

1. Call out a single number (for example, 20). Students are to write down as many equivalents for that number as they can think of (for example 10 + 10, 30 - 10, 20 + 0).
2. Then, have students, take turns suggesting their equivalents, seeing how long of a list the class can develop.
3. As a variation, call out a number (for example, 225) and have students write down as many different ways of writing that number as they can think of (for example, 200 + 20 + 5; 225 ones; 22 tens + 5 ones; two hundreds + twenty-five ones; two hundreds + two tens + five ones).

ACTIVITY: Parts of the Whole GRADE: Early

Purpose: To help students develop skill in conceptualizing fractions

Materials: Sets of Objects, Chalkboard, and Drawing Paper

Directions:

1. Give students sets of objects (for example, a set of 12 beans). Then ask them to divide the set into equal-sized smaller sets (for example, two sets of six objects, three sets of four objects). Provide or have students supply the appropriate fractional name to label each division of objects (for example, halves, thirds, fourths).
2. Direct students to form various configurations with their objects (for example, placing one-third of the objects under a piece of paper and leaving two-thirds of the objects uncovered).
3. Write a group of proper fractions on the chalkboard. The denominators of these fractions should range between 2 and 12. Ask students to prepare drawings to illustrate each fraction.
4. Display students' work to demonstrate the various ways each fraction can be represented.

ACTIVITY: People-Graphs GRADE: Early

Purpose: To familiarize students in the formation as well as interpretation of graphs

Materials: Chalk

Make a chalkline at one side of an open area. The chalkline should be evenly divided and labeled with heading based on an characteristic common to all students. This attribute might be month of birth, hair color, number of sisters and brothers, etc. The headings may be chalked on the floor or printed on signs.

Directions:

1. Ask students to line up behind the appropriate labels, thus forming a living graph.

2. Call on individual students to answer questions about information presented in the living graph (for example, "What color eyes do the greatest number of children have?").

3. Students can suggest their own ideas for characteristics for a graph. After a living graph has been formed, students may transfer the information gathered to a bar or picture graph which they prepare themselves.

ACTIVITY: Show Me GRADE: Early

Purpose: To promote learning of many different numerical concepts

Materials: Chalkboard

Directions:

1. Write a single number on the chalkboard. Use either its numerical or word form.

2. Direct students to find a concrete way to represent what has been written. They might, for example, collect five objects to exemplify the word "five," or fold a paper in thirds and then cut off one piece to demonstrate the number $\frac{2}{3}$.

3. Compare and discuss the various representations that students present.

ACTIVITY: Another Way GRADE: Later

Purpose: To provide practice using mathematical symbols and terminology

Materials: Chalkboard and Verbal Sentence

Write a verbal sentence on the Board.

Example: Nine hundred ninety-nine and nine hundredths is less than ten times one hundred.

Directions:

1. Ask students to substitute as many mathematical symbols as they can for the words used.

   Example: $999.09 < 10 \times 100$

2. Practice the activity in reverse by writing a mathematical sentence on the board and asking students to translate it into words.

   Example: Nine hundred ninety nine and nine hundredths is less than the product of ten and one hundred.

3. Have students take turns making up verbal and mathematical sentences to present to the rest of the class for translation. A class collection of "super sentences" might be developed, based on sentences that have proved particularly challenging.

ACTIVITY: What's My Number GRADE: Later

Purpose: To promote logical thinking as well as knowledge of numerical equivalents and relationships

Materials: None

Directions:

1. Select a student to play the role of a number. Introduce this student to the rest of the class in a manner that gives a clue as to the student's number identity. For example, "Mr. X is a whole number between 2 and 15" or "Ms. Y is an improper fraction between 2 and 7".

2. The other students take turn asking questions of the mystery number. Only questions answerable "yes" or "no" are allowed.

   Example: "Are you an even number?"

3. Any student who wishes to do so may try to guess the number's identity. If the student is correct, he or she becomes the next mystery number. Incorrect guessers are out of the game until the next round of play.

4. The game can be made more difficult by eliminating any clues as to the number's identity when introducing the mystery number and by broadening the range of numbers eligible for play. Students will have to structure their questions to find out the mystery number's identity and the range in which it falls.

   Example: "Are you a whole number?" (Answer: Yes)
   "Are you between 1 and 50?" (Answer: No)
   "Are you between 50 and 100?" (Answer: Yes)

ACTIVITY: Number Call Out GRADE: Later

Purpose: To increase students' familiarity with number equivalents

Materials: Blank Bingo Cards, Number Lists, and Card Markers

Prepare sets of blank bingo cards (i.e., cards divided into 25 squares). Also, prepare lists of 40-50 decimal numbers, fractions, mixed numbers, percentages, or ratios.

Directions:

1. Decide which list of numbers to use for a series of games. Distribute the list to students along with one or more blank game cards for each player.

2. Allow students time to fill in their bingo cards. Students must write a different number in each square. All numbers must be equivalents for numbers contained on the list which was passed out previously. For example, if the list contained the decimal fraction .25, students could enter 25% or $\frac{1}{4}$ or 1:4 on their card.

3. Play begins when numbers are selected at random from the number list and then called out to the class. Students use markers to cover each number on their card that is an equivalent for a number called.

4. Potential winners must have their cards checked to verify that the equivalencies identified were the correct ones.

ACTIVITY: Questions and Answers **GRADE:** Later

Purpose: To provide a lesson in survey methods as well as the preparation of tables and graphs

Materials: Drawing and/or Graph Paper

Directions:

1. Have the class decide on an interesting survey question to ask people. A question with several possible answers should be selected (for example, "What is your favorite food?").

2. Each student is to ask the question of several people out of class and record the answers received.

3. After tabulating the data collected, the class should discuss the ways in which that information can be presented.

4. Working alone or in groups, students prepare all the various types of tables and/or graphs that can be made based on the survey results. (For instance, there might be a circle graph, a bar graph, and a table.)

5. When all the representations are completed, discuss the advantages and disadvantages of each form, noting whether any one is a more effective means of presentation than the others.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: All

Test Item Description: Overview

For Concepts, the student is presented with displays of objects, geometric figures, charts and graphs, maps, numbers, and mathematical expressions. The student uses the information presented to answer questions about counting, identifying equivalencies, establishing relationships, determining place value, and/or interpreting tables and graphs.

As grade levels increase, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, NATURE OF PROBLEM and COUNTING UNITS).

1. Counting - The student should be able to count larger numbers of objects and count by ones, twos, fives, tens, and so forth.

2. Identifying Equivalencies - The student should be able to identify equivalent forms of the same number. The types of numbers eligible and ranges of numbers become increasingly more difficult.

3. Establishing Relationships - The student is confronted with comparisons which incorporate the symbols <, >, and =. The expressions initially contain no operational symbols but do so in the later grades.

4. Determining Place Value - The student should be able to translate words and numbers into symbols and vice versa. In the later grades, powers of ten and exponential form may be used. The eligible places (ones, tens, etc.) incorporate decimal fractions in the later grades.

5. Interpreting Tables and Graphs - This skill becomes more difficult in terms of the types of graphs, the number of graph/table dimensions, and whether or not computations must be performed in deriving the graph/table reading.

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
DETERMINING PLACE VALUE	NATURE OF PROBLEM	Expression containing words and numerals	Expression containing words and numerals	Expression containing words and/or numerals			Expression containing words, numerals, and/or powers of 10		Expression containing words, numerals, and/or exponential form	
	TYPES OF NUMBERS	2-digit whole numbers	2-3 digit whole numbers	2-3 digit whole numbers			3-4 digit whole numbers		4-5 digit whole numbers and decimals	
	PLACES	Ones	Ones, tens	Ones, tens, hundreds			Ones, tens, hundreds, thousands		One tens, hundreds, thousands, and decimal fractions	
INTERPRETING TABLES AND GRAPHS	NATURE OF PROBLEM	Reading and using information from tables and graphs	Reading and using information from tables and graphs Level of interpretation higher than at previous grade	Reading and using information from tables and graphs Level of interpretation higher than at previous grade			Reading and using information from tables and graphs Level of interpretation higher than at previous grade		Reading and using information from tables and graphs Level of interpretation higher than at previous grade	
	TYPES OF TABLES AND GRAPHS		Picture or bar graphs No tables	Picture or bar graphs No tables			Picture, bar, or circle graphs No tables		Picture, bar circle, or line graphs Tables	
	TYPES OF NUMBERS		1 digit whole numbers	1-2 digit whole numbers			1-2 digit whole numbers		1-3 digit whole numbers	
	DIMENSIONS		Graphs: up to 4 X 4	Graphs: up to 6 X 6			Graphs: up to 10 X 10		Graphs: up to 12 X 12 Tables: up to 5 X 5	
	COMPUTATIONS REQUIRED		None	None			None		One	

*Refer to the Suggested Measurement Strategy for the State Objective.

SKILL DIFFICULTY CHART

OBJECTIVE: Concepts GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
COUNTING	NATURE OF PROBLEM	Counting objects	Complete a sequence of numbers	Complete a sequence of numbers			Not tested		Not tested	
	COUNTING UNITS	10-25 objects	Whole numbers, 1-399	Whole numbers, 1-999						
IDENTIFYING EQUIVALENCIES	NATURE OF PROBLEM	Identifying equivalent forms of numbers	Identifying equivalent forms of numbers	Identifying equivalent forms of numbers			Identifying equivalent forms of numbers		Identifying equivalent forms of numbers	
	WORD NAME EQUIVALENTS	Word names of numbers 0-10	Word names of numbers 10-399	Word names of numbers 20-999			Word names of 3- or 4-digit numbers .001-999.9		Word names of numbers .001-9999.999	
	NUMERICAL EQUIVALENTS	Not tested	Fractions: halves, thirds, fourths, fifths	Fractions: thirds to twelfths			Decimals, fractions, mixed numbers, percents		Decimals, fractions, mixed numbers, percents, ratios	
ESTABLISHING RELATIONSHIPS	NATURE OF PROBLEM	Comparing sets of objects	Comparing whole numbers	Comparing whole numbers to arithmetic expressions			Comparing fractions		Comparing fractions	
	TYPE OF COMPARISON	One to one correspondence	Relational expression involving (<, >, =) and no operational symbols	Relational expression involving (<, >, =) and (+, -, x)			Relational expression involving (<, >, =)		Relational expression involving (<, >, =)	

*Refer to the Suggested Measurement Strategy for the State Objective.

CN-7.1

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Concepts GRADE: 7

Objective

The student can apply numerical concepts.

Suggested Measurement Strategy

Answering questions about numerical quantities and representations. These questions may require comprehending mathematical symbols and terminology, identifying equivalent ways of expressing the same numerical quantity, establishing relationships between numerical quantities, estimating, determining place value, creating or comparing sets, using formulas, developing or interpreting graphs, using tables, or establishing ratios or proportions.

Subskills

The open circles O indicate the subskills for you to consider in your instruction.

1. Counting

   The student can count.

○ 2. Identifying Equivalencies

   The student can identify equivalent ways of expressing the same numerical quantity.

○ 3. Establishing Relationships

   The student can establish relationships between numerical equalities.

○ 4. Determining Place Value

   The student can determing the place value of numerical qualities.

○ 5. Interpreting Tables and Graphs

   The student can extract information from tables and graphs.

6. Recognizing Square Roots

   The student can recognize common square roots.

7. Using Formulas

   The student can apply formulas.

OBJECTIVE: Concepts GRADE: 7

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Numerical Representations

The student can interpret the numerical representations for whole numbers, fractions, decimals, and percents. For example, given the numerical representation "$\frac{2}{3}$", the student associates that symbol with "two-thirds".

○ 2. Comprehension of Mathematical Terminology

The student understands the following types of mathematical vocabulary: (1) the word forms for whole numbers, fractions, and decimals; (2) names referring to place value (for example, "hundredths place"); (3) relationship words (for example, "most", "least"); (4) sequencing words (for example, "before", "next"); and (5) phrases requiring the determination of a quantity (for example, "how much", "how many", "what part").

○ 3. Comprehension of Mathematical Symbols

The student understands the following types of symbols: (1) operational signs (that is, +, -, x, and ÷); (2) relations symbols (that is, =, <, and >); and (3) symbols used in conjunction with numbers (that is, decimal point, percentage sign, exponent).

○ 4. Comprehension of Numerical Sequence

The student understands that numbers can be (1) arranged in ascending or descending order; (2) grouped by multiples; and (3) counted forwards or backwards.

○ 5. Comprehension of Graphic Representations

The student understands that numerical quantities and data relationships can be represented either visually, (that is, in picture, circle, and bar graphs) or through a coordinate system of rows and columns (for example, in tables).

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Concepts
SUBSKILL: Identifying Equivalencies

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts
SUBSKILL: Establishing Relationships
GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts
SUBSKILL: Determining Place Value

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts
SUBSKILL: Interpreting Tables and Graphs
GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

CN-8.1

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Concepts GRADE: 8

Objective

The student can apply numerical concepts.

Suggested Measurement Strategy

Answering questions about numerical quantities and representations. These questions may require comprehending mathematical symbols and terminology, identifying equivalent ways of expressing the same numerical quantity, establishing relationships between numerical quantities, estimating, determining place value, creating or comparing sets, using formulas, developing or interpreting graphs, using tables, or establishing ratios or proportions.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

1. Counting

   The student can count.

● 2. Identifying Equivalencies

   The student can identify equivalent ways of expressing the same numerical quantity.

● 3. Establishing Relationships

   The student can establish relationships between numerical equalities.

● 4. Determining Place Value

   The student can determing the place value of numerical qualities.

● 5. Interpreting Tables and Graphs

   The student can extract information from tables and graphs.

6. Recognizing Square Roots

   The student can recognize common square roots.

7. Using Formulas

   The student can apply formulas.

OBJECTIVE: Concepts GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Numerical Representations

The student can interpret the numerical representations for whole numbers, fractions, decimals, and percents. For example, given the numerical representation "$\frac{2}{3}$", the student associates that symbol with "two-thirds".

○ 2. Comprehension of Mathematical Terminology

The student understands the following types of mathematical vocabulary: (1) the word forms for whole numbers, fractions, and decimals; (2) names referring to place value (for example, "hundredths place"); (3) relationship words (for example, "most", "least"); (4) sequencing words (for example, "before", "next"); and (5) phrases requiring the determination of a quantity (for example, "how much", "how many", "what part").

○ 3. Comprehension of Mathematical Symbols

The student understands the following types of symbols: (1) operational signs (that is, +, -, x, and ÷); (2) relations symbols (that is, =, <, and >); and (3) symbols used in conjunction with numbers (that is, decimal point, percentage sign, exponent).

○ 4. Comprehension of Numerical Sequence

The student understands that numbers can be (1) arranged in ascending or descending order; (2) grouped by multiples; and (3) counted forwards or backwards.

○ 5. Comprehension of Graphic Representations

The student understands that numerical quantities and data relationships can be represented either visually, (that is, in picture, circle, and bar graphs) or through a coordinate system of rows and columns (for example, in tables).

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Concepts
SUBSKILL: Identifying Equivalencies

GRADE: 8

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

$$\boxed{\frac{9}{12} = \frac{?}{16}}$$

What number makes the sentence true?

(A) 9

(B) 12 (correct)

(C) 10

(D) 8

Write Your Own Item

Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 8
SUBSKILL: Establishing Relationships

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)

$$\boxed{\underline{\quad ? \quad} < \frac{17}{45}}$$

What fraction makes this sentence true?

(A) $\frac{1}{3}$ (correct)

(B) $\frac{2}{3}$

(C) $\frac{2}{5}$

(D) $\frac{4}{9}$

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 8
SUBSKILL: Determining Place Value

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

4 ones 7 tens 6 hundredths 9 thousandths

What number is the same as the number in the box?

(A) 7.469

(B) 47.96

(C) 74.069 (correct)

(D) 9674

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 8
SUBSKILL: Interpreting Tables and Graphs

Sample Item and Directions

(Teacher reads.)

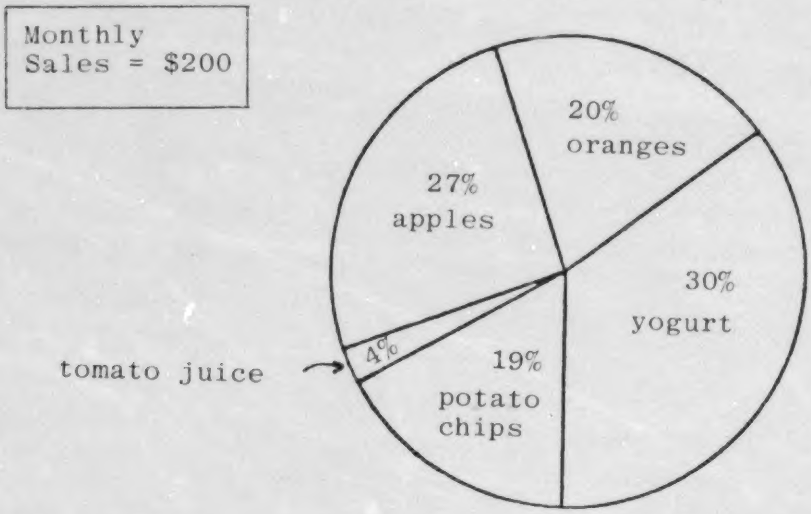
Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

SOURCES OF VENDING MACHINE INCOME



How much money is made on tomato juice each month?

(A) $ .40

(B) $ .50

(C) $4.00

(D) $8.00 (correct)

Write Your Own Item

Use the back of this page.

Operations

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TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Operations GRADE: All

Objective

The student can compute accurately.

Explanation

The ability to perform operations with various types of numbers represents a skill that permeates all of the mathematics objectives. This skill requires mastery of the basic arithmetic facts as well as familiarity with the operational algorithms for whole numbers, decimals, fractions, and percents.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Addition The student can add accurately.	●	●	●	O	O	●	O	●	O	O	●	O
2. Subtraction The student can subtract accurately.	●	●	●	O	O	●	O	●	O	O	●	O
3. Multiplication The student can multiply accurately.		O	●	O	O	●	O	●	O	O	●	O
4. Division The student can divide accurately.			●	O	O	●	O	●	O	O	●	O

OBJECTIVE: Operations GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Knowledge of Basic Number Facts The student can add, subtract, multiply, and divide all possible pairs of one-digit numbers.	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Place Value The student can apply place value concepts when setting up and solving a problem.	O	O	O	O	O	O	O	O	O	O	O	O
3. Ability to Perform a Series of Computations The student can perform in a correct sequence all of the individual computations needed to solve a computational problem.	O	O	O	O	O	O	O	O	O	O	O	O
4. Ability of Regroup The student can regroup accurately as required by a problem. This includes knowing when in a computation to regroup, what quantity to regroup, and the place values of the numbers involved in the regrouping.		O	O	O	O	O	O	O	O	O	O	O
5. Understanding of Fractions The student can identify a fraction's numerator and denominator. The student knows how to manipulate each part of a fraction when performing a calculation with that number.		O	O	O	O	O	O	O	O	O	O	O
6. Ability to Operate with Fractions The student can find the lowest common denominator for two fractions, convert a fraction with one denominator, and reduce an improper fraction to its lowest terms.				O	O	O	O	O	O	O	O	O

WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Operations GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Addition	
2. Subtraction	
3. Multiplication	
4. Division	

OP-0.4

ACTIVITY: Fun with Facts GRADE: Early

Purpose: To provide students with opportunities to review the basic number facts

Materials: Crossword puzzles, Blank Bingo Cards and Markers

EXAMPLE:

1) 3	2) 3	■	4) 1
5) 4	6) 5	■	8) 2

(etc.)

Across

1) 3 x 11 = ____

5) 23 + 22 = ____

Down

1) 29 + 5 = ____

2) 7 x 5 = ____

4) 3 + 3 + 3 + 3 = ____

Directions:

Have students do activities such as the following for reviewing basic number facts.

1. Prepare crossword puzzles that have numbers instead of words for answers.

2. Have students fill in blank bingo cards with computational problems that result in an integer between 1-81 (for example, 6 - 2, 3 x 4, 8 + 6, 9 - 7). As numbers are called, students cover any squares on their card which result in that solution. Then play the game in reverse, with students entering integers on their cards and the caller reading out simple computational problems.

ACTIVITY: Picture That GRADE: Early

Purpose: To provide practice in solving simple pictorial fraction problems

Materials: Large Sheets of Paper

Directions

1. Distribute paper to each student.

2. Students are to draw a fraction problem in each section. For example, they might draw two squares, one divided into fourths with two fourths shaded and the other divided into fourths with one fourth shaded. Students also include a "+" or "-" operational sign.

3. On a separate sheet of paper (answer sheet) students record the numerical form of each problem and its correct answer (for example, $\frac{2}{4} - \frac{1}{4} = \frac{1}{4}$).

4. Students exchange their drawings and then try to solve each other's problems. Answers are checked against the answer sheets.

ACTIVITY: Going Backwards GRADE: Early

Purpose: To provide practice on basic operations skills

Materials: List of Numbers, Chalkboard

Write a list of numbers on the chalkboard. This list represents the answers for which students are to supply the problems. The answers may be whole numbers and/or proper fractions, depending upon the level of the class.

Directions:

1. Have students devise as many problems as they can that result in each answer given. These problems may require addition, subtraction, multiplication, or division.

2. Check each student's problems, to make sure they result in the answers given. Prizes could be awarded to the students who created the most number of correct problems.

ACTIVITY: Related Operations GRADE: Later

Purpose: To promote understanding of the basic idea of multiplication and division sentences and teach the words associated with such sentences

Materials: Multiplication Cards

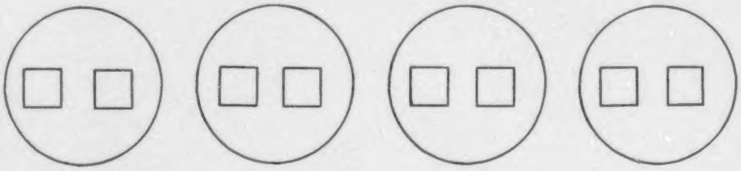
Directions:

1. For multiplication, make cards for the necessary words and symbols and then manipulate those cards to show a sentence.

   Example: FACTOR X FACTOR = PRODUCT

2. Then relate the multiplication sentence to the models for multiplication.

   Example:



   4 sets of 2 is 8

   4 x 2 = 8

   FACTOR X FACTOR = PRODUCT

3. Follow a similar procedure with division, in this instance showing the relationship between the two operations.

   FACTOR X FACTOR = PRODUCT

   Example:

   FACTOR ÷ FACTOR = FACTOR

4. Prepare exercises such as the following and instruct the class to write two related divison sentences for each multiplication sentence.

   a. 3 x 6 = 18
   b. 7 x 5 = 35
   c. 4 x 9 = 36
   d. 7 x 8 = 56

ACTIVITY: Palindrome Puzzles **GRADE:** Later

Purpose: To provide practice in addition skills through the use of mathematical puzzles

Materials: Paper and Pencil

Directions:

1. Tell students they will be creating palindromes. A palindrome is a number that reads the same from left to right or right to left, for example, 121.

2. Have them begin by choosing any two or three digit number. Next they are to reverse the digits in that number and sum the two addends.

3. The process continues until the sum is a palindrome.

Example:

$$\begin{array}{r} 649 \\ +\ \ 946 \\ \hline 1595 \\ +\ 5951 \\ \hline 7546 \\ +\ 6457 \\ \hline 14003 \\ +\ 30041 \\ \hline 44044 \end{array}$$

ACTIVITY: Calamity Kid GRADE: Later

Purpose: To provide practice in completion of a series of calculations and to provide knowledge of commonly-occuring types of errors made in performing basic calculations

Materials: Written Sets of Basic Computational Problems

Prepare sets of basic computational problems at a level of difficulty appropriate for the content currently being studied by students. Each problem should be presented in a format that shows a solution plus all the calculations necessary to reach that solution.

Some of the problems should be worked correctly and some incorrectly. The incorrect solutions should be based on errors commonly made by students. These errors include incorrectly adding, subtracting, multiplying or dividing single digits, failing to regroup when necessary, regrouping when not necessary, incorrectly lining up digits, and performing the wrong operation.

Directions:

Have students check each problem and indicate whether it is correct or incorrect. Have students reword all incorrect problems so that they are correct. Students can also be asked to categorize the type of error occuring in each incorrect problem.

ACTIVITY: What's Possible GRADE: Later

Purpose: To provide practice for students in checking their calculational work

Materials: Word Problems

For each of several problems, write one or more proposed answers. The steps in arriving at the proposed answers to each problem may or may not be shown.

Directions:

1. Distribute copies of the problems to students. Do not allow students time to work the problems.
2. Have students indicate, for each problem, which of the proposed answers seem reasonable and which ones seem unreasonable.
3. Discuss with students the correct choices as well as strategies for approximating answers to calculational problems without actually computing an exact solution.

ACTIVITY: Name That Prime GRADE: Later

Purpose: To provide practice in finding prime numbers and least common denominators

Materials: Chalkboard

Directions:

1. Divide the class into two teams.

1 13 5 8 18 4
3 9 15
2 14 6 12 17 11 10 16 7

2. Place a group of numbers on the chalkboard as illustrated below.

3. Call out a number (for example, "35"). The first player on the first team reports all the prime factors for that number, using only the set available on the board. One point is scored for each factor named.

4. When the first player on the first team is finished, the first player on the other team has a chance to add any additional prime factors that have not been named or to dispute, as incorrect, any factors that have been named. Two points are scored for each correct addition or deletion this player makes.

5. Play continues to alternate between the two teams, with each one receiving an equal number of chances to respond first to the number called out by the teacher and to judge the correctness of another player's responses.

6. The set of factors to be considered can be changed frequently adding variety to the game.

7. Prime numbers alone may be used in this game as the numbers called out by the teacher. If they are included, any player who first identifies a number as a prime scores three points.

ACTIVITY: Take the Challenge GRADE: Later

Purpose: To provide practice in basic operations skills

Materials: Computation Exercise Sheets

On sheets of paper, list the kinds of problems that teams are to create. For example, the sheet might say: "Make up two multiplication problems. Each one must have two mixed numbers, neither one of which can be greater than 20. Each must have different denominators in the fractions. Neither denominator can be greater than 6."

Directions:

1. Divide the class into teams. Each team receives a computation exercise sheet.

2. Each team prepares the specified number of problems, along with an answer key.

3. Teams exchange problems and compete to see which team can solve all of the other team's problems most rapidly.

4. Answers are checked against the answer key provided and any disagreements arbitrated by the teacher or a panel of student judges chosen for this purpose.

5. The number and difficulty level of eligible computational problems can both be increased gradually over time.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Operations GRADE: All

Test Item Description: Overview

For Operations, the student is presented with a computational problem. The student must add, subtract, multiply, and/or divide to determine the answer to the problem.

As grade levels increase, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, TYPES OF NUMBERS). TYPES OF NUMBERS and algorithmic complexity (NUMBER OF REGROUPINGS, REDUCING REQUIRED, etc.) are the primary considerations. Students are expected to be able to perform the various computations regardless of format.

1. Addition - The student should be able to add using different types of numbers. As grade levels increase, the numbers of addends and regroupings may also increase.

2. Subtraction - The student should be able to subtract using different types of numbers. As grade levels increase, the number of regroupings, as well as the use of zeros may also increase.

3. Multiplication - The student should be able to subtract using different types of numbers. As grade levels increase, the number of factors and the number of regroupings, as well as the use of zeros and the number of digits in the multiplicand and multiplier may also increase.

4. Division - The student should be able to divide using different types of numbers. As grade levels increase, the types of numbers, as well as the use of zeros may also increase. Students are expected to be able to record remainders in various formats (whole number, fractional, and decimal remainders).

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
ADDITION	NUMBER OF ADDENDS	2-3	2-4	2-5			2-4		2-4	
	NUMBER OF REGROUPINGS	0	0-1	0-2			0-3		0-4	
SUBTRACTION	NUMBER OF REGROUPINGS	0	0-1	0-2			0-3		0-4	
MULTIPLICATION	NUMBER OF FACTORS	Not tested	Not tested	2			2-3		2-3	
	FORMAT			Horizontal or vertical			Horizontal or vertical		Horizontal or vertical	
	NUMBER OF DIGITS IN MULTIPLICAND AND MULTIPLIER			1-3 and 1			1-3 and 1-2		1-3 and 2	
DIVISION	REMAINDER?	Not tested	Not tested	Yes			Yes		Yes Fractional Remainders	
	FORMAT			Vertical			Use of both signs: $\overline{)\ }$ and ÷		Use of both signs: $\overline{)\ }$ and ÷	

*Refer to the Suggested Measurement Strategy for the State Objective.

SKILL DIFFICULTY CHART

OBJECTIVE: Operations GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
ALL SUBSKILLS	TYPES OF NUMBERS	Whole numbers, up to 2 digits (+ and - only)	Whole numbers, up to 3 digits (+ and - only)	Whole numbers, up to 3 digits Fractions, 1 digit per numerator/ denominator. (+ and - only)			Whole numbers, up to 3 digits Fractions, up to 2 digits per numerator/ denominator Decimals, up to 3 digits Mixed nos., up to 1 digit per numerator/ denominator		Signed integers, up to 2 digits Fractions, up to 2 digits per numerator/ denominator Decimals, up to 4 digits Mixed nos., up to 2 digits per numerator/ denominator Percents (x and ÷ only)	
	FORMAT	Horizontal or vertical	Horizontal or vertical	Horizontal or vertical			Horizontal or vertical		Horizontal or vertical	
	REDUCING REQUIRED?	No	No	No			Yes		Yes	
	FINDING COMMON DENOMINATOR REQUIRED?	No	No	No			No		Yes	

*Refer to the Suggested Measurement Strategy for the State Objective.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Operations GRADE: 7

Objective

The student can compute accurately.

Suggested Measurement Strategy

Determining the answers to exercises requiring a mathematical operation. The exercises to be solved may require adding, subtracting, multiplying, or dividing whole numbers, signed numbers, fractions, mixed numbers, decimals, or percents.

Subskills

The open circles O indicate subskills for you to consider in your instruction.

○ 1. Addition

The student can add accurately.

○ 2. Subtraction

The student can subtract accurately.

○ 3. Multiplication

The student can multiply accurately.

○ 4. Division

The student can divide accurately.

OBJECTIVE: Operations GRADE: 7

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Basic Number Facts

The student can add, subtract, multiply, and divide all possible pairs of one-digit numbers.

○ 2. Comprehension of Place Value

The student can apply place value concepts when setting up and solving a problem.

○ 3. Ability to Perform a Series of Computations

The student can perform in a correct sequence all of the individual computations needed to solve a computational problem.

○ 4. Ability to Regroup

The student can regroup accurately as required by a problem. This includes knowing when in a computation to regroup, what quantity to group and the place values of the numbers involved in the regrouping.

○ 5. Understanding of Fractions

The student can identify a fraction's numerator and denominator. The student knows how to manipulate each part of a fraction when performing a calculation with that number.

○ 6. Ability to Operate with Fractions

The student can find the lowest common denominator for two fractions, convert a fraction with one denominator, and reduce an improper fraction to its lowest terms.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Addition
GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: · Operations
SUBSKILL: Subtraction

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Multiplication
GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Division

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Operations GRADE: 8

Objective

The student can compute accurately.

Suggested Measurement Strategy

Determining the answers to exercises requiring a mathematical operation. The exercises to be solved may require adding, subtracting, multiplying, or dividing whole numbers, signed numbers, fractions, mixed numbers, decimals, or percents.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

● 1. Addition

The student can add accurately.

● 2. Subtraction

The student can subtract accurately.

● 3. Multiplication

The student can multiply accurately.

● 4. Division

The student can divide accurately.

OBJECTIVE: Operations GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Basic Number Facts

The student can add, subtract, multiply, and divide all possible pairs of one-digit numbers.

○ 2. Comprehension of Place Value

The student can apply place value concepts when setting up and solving a problem.

○ 3. Ability to Perform a Series of Computations

The student can perform in a correct sequence all of the individual computations needed to solve a computational problem.

○ 4. Ability to Regroup

The student can regroup accurately as required by a problem. This includes knowing when in a computation to regroup, what quantity to group and the place values of the numbers involved in the regrouping.

○ 5. Understanding of Fractions

The student can identify a fraction's numerator and denominator. The student knows how to manipulate each part of a fraction when performing a calculation with that number.

○ 6. Ability to Operate with Fractions

The student can find the lowest common denominator for two fractions, convert a fraction with one denominator, and reduce an improper fraction to its lowest terms.

OP-8.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Operations GRADE: 8
SUBSKILL: Addition

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

$$\boxed{\begin{array}{rr} 6 & \\ & \frac{2}{10} \\ +\,1 & \frac{3}{5} \\ \hline & \end{array}}$$

(A) $7\frac{1}{2}$

(B) $7\frac{1}{3}$

(C) $7\frac{4}{5}$ (correct)

(D) 8

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations GRADE: 8
SUBSKILL: Subtraction

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)

372.1 - 8.75 = ____

(A) 284.6

(B) 363.35 (correct)

(C) 363.45

(D) 384.85

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Multiplication

GRADE: 8

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

30% of 2.4 = ____

(A) .72 (correct)

(B) .8

(C) 1.5

(D) 8

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Division
GRADE: 8

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

5 is what percent of 20?

(A) 4%

(B) 20%

(C) 25% (correct)

(D) 40%

Write Your Own Item
Use the back of this page.

Measurement

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GRADE: 8

TEACHING OUR SKILLS

What Skills Ought to Be Considered ME-8.1

TESTING OUR SKILLS

How Skills Are Tested ME-8.2

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Measurement GRADE: All

Objective

The student can apply measurement concepts.

Explanation

Through the development of measurement skills, students can gather information about the world in which they live. These skills might first be developed using direct experiences involving measurable properties such as time, temperature, distance, weight, and volume. Students can begin to shape their expectations about the physical world through exploration and estimation of these properties. Later, students can investigate specific measurement tools and systems and find out about the appropriateness of various devices and measurement units for given situations they encounter. Estimation may be used as a means of determining if the results of their investigations are feasible. This skill should provide students with a powerful tool that they can use throughout their lives.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identifying Units of Measurement The student can determine the appropriate type of measurement and select the appropriate units of measurement within a given measurement system.	●	●	●	○	○	●	○	●	○	○	●	○
2. Estimation The student can estimate measurable quantities within a given measurement system.		○	●	○	○	●	○	●	○	○	●	○
3. Using Measuring Devices The student can read and interpret information by using a measuring device within a given measurement system.	●	●	●	○	○	●	○	●	○	○	●	○
4. Conversions and Operations The student can make necessary conversions using units of measurement within a given measurement system and can perform calculations which may involve conversions.		○	●	○	○	●	○	●	○	○	●	○
5. Scale Drawings The student can read, interpret, and construct scale drawings within a given measurement system.				○	○	●	○	●	○	○	●	○

OBJECTIVE: Measurement GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Interpretation of Pictured Measuring Devices The student can "read" representations of the various measuring devices (for example, clocks, scales, rulers, thermometers, etc.).	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Measurement Situations The student can analyze a situation described pictorially and/or verbally to determine, from the information given, what quantity or property is to be measured. This requires familiarity with the words used to describe measurable attributes (for example, "tall", "wide", "warm", "heavy", etc.).	O	O	O	O	O	O	O	O	O	O	O	O
3. Knowledge of Measurement Units, Abbreviations, and Symbols The student can recognize measurement units, symbols, and abbreviations and can associate each with a physical attribute it describes as well as a measurement device. For example, kilograms are a measure of weight determined by using a scale.	O	O	O	O	O	O	O	O	O	O	O	O
4. Selection of Appropriate Measurement Units The student can differentiate among the various units used to measure a particular attribute and recognize when each unit is most appropriate to use. For example, miles, not inches, are more appropriately used to measure long distances.		O	O	O	O	O	O	O	O	O	O	O
5. Knowledge of Measurement Equivalents The student knows measurement equivalents (for example, 12 inches = 1 foot, 60 seconds = 1 minute). This skill includes the ability to identify the larger/smaller unit of measure.		O	O	O	O	O	O	O	O	O	O	O
6. Determination of Measurement Plausibility The student is familiar with the physical properties of common objects and events so that the student can judge the reasonableness of estimations of those properties.			O	O	O	O	O	O	O	O	O	O
7. Interpretation of Scaled Measurement The student understands the concept of "scale distance" versus "actual distance" and can distinguish on a scale drawing between the units used to measure each.				O	O	O	O	O	O	O	O	O

TEACHING OUR SKILLS
WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Measurement GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Identifying Units of Measurement	
2. Estimation	
3. Using Measuring Devices	
4. Conversions and Operations	
5. Scale Drawings	

ACTIVITY: Let's Find Out GRADE: Early

Purpose: To provide students with experience in judging the relative magnitudes of objects and events

Materials: Chart

Directions:

The activities below can be used to help students with their measurement skills.

1. Have students select a motor activity to perform (for example, hopping 20 times or clapping their hands 50 times). Before performing the activity, students estimate how long it will take to complete. After writing down their estimates, students take turns timingeach other, then compare their estimates with the actual times.

2. Prepare a chart with headings that correspond to the various units that can be used to measure the same attribute (for example, 1 inch, 1 foot, and 1 yard; 1 ounce and 1 pound). Students first list those objects in the classroom they estimate are in each category, then measure each object to verify their approximations.

3. Have students identify some events and objects,the magnitudes of which they would like to know (for example, the weight of an elephant, the height of the tallest building in the United States, the temperature inside a pizza oven). Then have them try to figure out a way to obtain the desired information (for example, ask someone, write a letter, use an encyclopedia). Assign individual students the responsibility for finding out each answer. Students might enjoy publishing a newspaper with their findings so that they can share their efforts with other classes.

ACTIVITY: Draw It GRADE: Early

Purpose: To provide practice with skills that sharpen direction-following while also testing knowledge of specific measurement devices

Materials: Drawing Paper and Pencils or Crayons

Directions:

1. Supply students with drawing paper and pencils or crayons, then present a series of written or verbal directions.
2. Each set of directions should require students to draw a specified measuring device showing a designated measurement (for example, draw a clock that shows 10 a.m.; draw a cup that has 1/4 cup of milk in it; draw a thermometer that shows 50°C).
3. When students complete their drawings, they can exchange papers and check each other's work.

ACTIVITY: A New System GRADE: Early

Purpose: To broaden the concept of measurement by using non-standard measuring systems

Materials: Sticks of Two Lengths and Different-Sized Small Cans

Directions:

1. Make available sticks of two lengths. The sticks should not have markings of any kind. Students, working in pairs, are to measure the length of a designated object (for example, the chalk tray) using the longer stick. Students also are to name their new stick unit.

2. Next, have students measure the width of the room using the longer stick. Then they should repeat the activity using the shorter stick.

3. Have students compare and discuss their results, then decide which stick length is the more practical to use for each set of measurements.

4. Follow up on the activity above using groups of three or four students working together to measure various classroom objects or distances taped along the floor. Ask the groups to record their measurements, then have the groups compare results and answer questions.

   Example: "Is a measurement in short sticks equal to the same measurement in long sticks?"

   "Which stick is more practical for each job?"

5. Select an object for measurement that does not allow the stick length to fit an even number of times. Have students estimate the amount of the unit left over and lead them to the idea of rounding to the nearest whole unit.

6. Prepare an analogous activity to measure liquid. Use different sizes of small cans and sand or water. Conduct the same types of discussions about comparisons, practicality, and rounding, as outlined above for stickunits.

ACTIVITY: Units of Measurement GRADE: Later

Purpose: To provide students with practice in determining the appropriate unit of measure to use when determinig time, length, weight, volume, temperature, and area

Materials: Chalkboard

Directions:

1. As a class, make a list of measuring units available for each property to be studied, using either metric or customary units. Display the information, ordered from smaller to larger units, on the chalkboard or in a poster.

   Example: Length

   inch, foot, yard, mile; or
   millimeter, centimeter, meter, kilometer

2. Divide the class into small groups and appoint a recorder in each group.

3. Assign a measurable property and its measurement units to each group. The group's task is to think of objects that would most likely be measured in each unit.

   Example: Length

   Inch - pencil, book, paper clip
   Foot - car, tree, building
   Yard - length of the hallway
   Mile - highway distance

4. Call time after a predetermined number of minutes and have groups take new properties and start once again. All groups are to cover all properties.

5. When the activity is completed, groups should share their lists and compile a master list.

ACTIVITY: Conversion Matches GRADE: Later

Purpose: To provide practice converting between simple and compound measurements

Materials: Two Sets of Cards

Make one card deck, each card of which states a specified time, length, weight or volume (for example, 1 hour, 10 minutes).

Make a second card deck, each card of which matches a quantity specified in the first set of cards but describes that quantity in larger or smaller units (for example, 70 minutes).

Combine the two sets of cards into one deck. Shuffle well.

Directions:

1. Ask students to find the quantities that make a match.
2. Students should check each other's work to insure that the correct matches were made.

ACTIVITY: Long List GRADE: Later

Purpose: To promote understanding of various measurement usages

Materials: None

Directions:

1. Establish categories for places where measurement devices and concepts are frequently used (for example, home, school, work, recreation, travel).
2. Students, working alone or in groups, are to research the measurement devices and applications associated with each category, then report on these to the rest of the class.
3. As an option, students might be assigned to prepare a report on unusual measurement devices (that is, ones that have not been studied already in class).

ACTIVITY: Scaling It GRADE: Later

Purpose: To provide practice in preparing scale drawings which require students to apply several different measurement skills

Materials: Paper and Pencil

Directions:

1. Have students prepare scale drawings of common objects, using an agreed-upon scale for all of their drawings (for example, 1 cm = 1 m). Students exchange drawings, then verify the work of others.
2. Ask students to make several scale drawings of the same place (for example, their bedrooms or the school yard). Each drawing should use a different scale ratio (for example, 1 inch = 1 foot, 1 inch = 2 feet, 1 inch = 1 yard). Have students compare their drawings and comment upon which scale ratio seemed most appropriate and why.
3. Have students apply the concept of scale to other measurable attributes. For example, if 1 sec. = 1 min., how long would an hour television show be if it were reduced to scale?
4. Locate or prepare a series of scale drawings and maps. Remove the scale ratio from each but leave on the indicators of actual length or distance. For instance, a map might be labeled to show the distance, in miles, between major cities. Provide students with rulers and have them determine the scale ratio that was used to prepare each drawing or map.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: All

Test Item Description: Overview

For Measurement, the student must be familiar with measurement units and devices in order to find the exact or most reasonable answer to the question. The questions may require identifying measurement units, estimation, using measurement devices, performing conversions and operations, and using scale drawings.

As grade level increases, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, MEASUREMENT SYSTEMS, TYPES OF UNITS, etc.). Students should be able to perform all skills within the same measurement system, customary or metric.

1. Identifying Units of Measure - The student should be able to select the most appropriate unit of measure for measuring a given object named or pictured. The types of measurement units eligible for testing vary as grade levels increase.

2. Estimation - The student should be able to estimate measurable quantities such as size, time, and weight. The types of measurement units eligible for testing vary as grade levels increase.

3. Using Measuring Devices - The student should be able to read and interpret information from a measuring device. Discriminations in readings become increasingly more refined.

4. Conversions and Operations - The student should be able to initially convert units of measurements and then regroup with units; and finally, in later grades perform calculations involving conversions within the same system. The eligible conversions increase with grade level.

5. Scale Drawings - The student is presented with a scale drawing such as a map, floor plan, or blueprint. The student should be able to read the scale and provide the actual measure and vice versa. As grade levels increase, the scale factor may require the use of fractional units.

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
CONVERSIONS AND OPERATIONS	NATURE OF PROBLEM	Not tested	Not tested	Converting from one unit to another in the same system			Converting from one unit to another in the same system		Computing (+, -, or x) with units in the same system (customary or metric) Compound Measurement for customary eligible	
	TYPES OF NUMBERS			Not tested			Customary: 1- or 2-digit integers, or fractions or mixed numbers with 1-digit numerators and denominators Metric: 1- to 3-digit decimals		Customary: 1-2 digit integers Metric: 1- to 2-digit integers	
	REGROUPING REQUIRED?			No			Yes, from one unit of measure to antoher		Yes, from one unit of measure to another	
SCALE DRAWINGS	NATURE OF PROBLEM	Not tested	Not tested	Not tested			Reading maps, floor plans, or blueprints		Reading maps, floor plans, or blue prints	
	SCALE CONVERSIONS						Customary: inches (scale) to feet or miles (actual) Metric: centimeters (scale) to meters or kilometers (actual)		Customary: inches (scale) to feet or miles (actual) Metric: centimeters (scale) to meters of kilometers (actual)	
	SCALE FACTOR						Multiple of 10		1-3 digit whole number or decimal	

*Refer to the Suggested Measurement Strategy for the State Objective.

ME-0.11

SKILL DIFFICULTY CHART

OBJECTIVE: Measurement GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
ALL SUBSKILLS	MEASUREMENT SYSTEMS	Metric or customary	Metric or customary	Metric or customary			Metric or customary		Metric or customary	
	TYPES OF UNITS	See Content Supplement, Units, Conversions, and Abbreviations, Grade 1.	See Content Supplement, Units, Conversions, and Abbreviations, Grades 1-2.	See Content Supplement, Units, Conversions, and Abbreviations Grades 1-3.			See Content Supplement, Units, Conversions, and Abbreviations, Grades 1-6.		See Content Supplement, Units, Conversions, and Abbreviations, Grades 1-8.	
IDENTIFYING UNITS OF MEASURE	NATURE OF PROBLEM	Identify money or time units or choose an appropriate device for measuring height, temperature, time, or weight	Choose an appropriate unit of measure	Choose an appropriate unit of measure			Choose an appropriate unit of measure		Choose an appropriate unit of measure	
ESTIMATION	NATURE OF PROBLEM	Not tested	Not tested	Estimating size, time, or weight of a displayed measurable quantity			Estimating size, time, or weight of a displayed measurable quantity		Estimating size of a planar or solid shape or a displayed measurable quantity (square or cubic units)	
USING MEASURING DEVICES	TYPES OF MEASURING DEVICES	Clocks	Clocks, rulers, thermometers, scales, money, calendar	Clocks, rulers, thermometers, scales, money, calendar, measuring cups			Not tested		Protractors	
	NATURE OF PROBLEM	Reading information from measurement devices See Content Supplement, Readings for Measurement Devices, Grade 1.	Reading information from measurement devices See Content Supplement, Readings for Measurement Devices, Grade 2.	Reading information from measurement devices See Content Supplement, Readings for Measurement Devices, Grade 3.					Reading information from measurement devices	

* Refer to the Suggested Measurement Strategy for the State Objective.

ME-0.12

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

READINGS FOR MEASUREMENT DEVICES

OBJECTIVE: Measurement GRADE: 1-3

Grade 1

Clocks

Face with hours numbered is used. Readings are to hour times only.

Grade 2

Clocks

Face with hours numbered is used. Readings are to hour or ½ hour.

Money

Two to three different coins (penny, nickel, dime, quarter, half-dollar) or 1 dollar bill are eligible.

Thermometers

1°F or 1°C graduations, numbered every 10°, are used. Readings are to nearest 10°. Scale is from -10°F to 110°F or from -20°C to 50°C.

Rulers

1 inch or 1 centimeter graduations are used. Units are actual size. Each graduation is numbered. Readings are to 1 inch or 1 centimeter.

Scales

(1 lb. or 1 kg graduations) Readings are to 1 lb. with numbers ≤ 20 lbs. Readings are to 1 kg with numbers ≤ 20 kg.

(10 lb. or 10 kg graduations) Readings are to 10 lb. or 10 kg with numbers ≤ 100 lbs. or ≤ 100 kg.

Calendars

One month displayed. No abbreviations. Ordinal numbers may be used.

OBJECTIVE: Measurement GRADE: 1-3

Grade 3

Clocks

Face with numbered hours is used. Readings are to nearest hour, ½ hour, or ¼ hour.

Money

Four to five different coins (penny, nickel, dime, quarter, half-dollar) or bills ($1, $5, $10, $20) are eligible.

Thermometers

1°F or 1°C graduations are used. Graduations are numbered every 10°. Readings are to nearest 5°F or 5°C. Scale is from 5°F to 100°F or from 5°C to 50°C.

Rulers

½ inch or 1 centimeter graduations are used. Units are actual size. Each graduation is numbered. Readings are to nearest ½ inch or 1 centimeter.

Scales

1 lb. or 1 kg graduations are used. Graduations are numbered every 5 units. Readings are to 1 lb. with numbers ≤100 lbs. or to 1 kg with numbers ≤100 kg.

Measuring Cups

¼ cup or 50 mL graduations are used. Readings are to nearest ¼ cup or 50 mL. Values from 0 to 1 cup or 0 to 250 mL.

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, AND ABBREVIATIONS

OBJECTIVE: Measurement GRADE: 1-3

This supplement is cumulative in the sense that units, conversions, and abbreviations at each grade should also be considered at subsequent grades.

Grade 1

Time

days of the week
months of the year
seasons of the year

Money

penny (1¢)
nickel (5¢)
dime (10¢)
quarter (25¢)

Grade 2

Time

(No additional units, conversions, or abbreviations)

Money

half-dollar (50¢)
dollar ($1.00)

Length

inches
centimeters

Weight

pounds
kilograms

Volume

cups

Temperature

°C
°F

OBJECTIVE: Measurement GRADE: 1-3

Grade 3

Time

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
12 months = 1 year

Money

5 pennies = 1 nickel
2 nickels = 1 dime
5 nickels = 1 quarter
5 dimes = 1 half-dollar
2 quarters = 1 half-dollar
100 pennies = 1 dollar
$5, $10, and $20 bills may be shown.

Length

1 foot = 12 inches
1 yard = 36 inches
1 yard = 3 feet
1 meter = 100 centimeters

Weight

(No additional units, conversions, or abbreviations)

Volume

2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon

Temperature

(No additional units, conversions, or abbreviations)

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, AND ABBREVIATIONS

OBJECTIVE: Measurement GRADE: 4-6

This supplement is cumulative in the sense that units, conversions, and abbreviations at each grade should also be considered at subsequent grades.

Grades 4 & 5

(Grades 1-3 units, conversions, and abbreviations and any other appropriate ones)

Grade 6

Time

(No additional units, conversions, or abbreviations)

Money

(No additional units, conversions, or abbreviations)

Length

1 mile = 5280 feet
1 centimeter = 10 millimeters
1 kilometer = 1000 meters
1 meter = 1000 millimeters

Weight

16 ounces = 1 pound
1 ton = 2000 pounds
1 kilogram = 1000 grams
1 metric ton = 1000 grams

Volume

1 liter = 1000 milliliters

Temperature

(No additional units, conversions, or abbreviations)

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, AND ABBREVIATIONS

OBJECTIVE: Measurement GRADE: 7 & 8

This supplement is cumulative in the sense that units, conversions, and abbreviations at each grade should also be considered at subsequent grades.

Grade 7

(Grades 1-6 units, conversions, and abbreviations and any other appropriate ones)

Grade 8

Time

second(s) = sec.
minute(s) = min.
hour(s) = hr(s).
week(s) = wk(s).

Money

(No additional units, conversions, or abbreviations)

Length

meter(s) = m
centimeter(s) = cm
millimeter(s) = mm
kilometer(s) = km
foot/feet = ft.
inch(es) = in.
yard(s) = yd.
mile(s) = mi.

OBJECTIVE: Measurement GRADE: 7 & 8

Grade 8 (continued)

Weight

ounce(s) = oz.
pound(s) = lb.
kilogram(s) = kg
gram(s) = g

Volume

cup(s) = c.
pint(s) = pt.
quart(s) = qt.
gallon(s) = gal.
liter(s) = L
milliliters = mL

Temperature

(No additional units, conversions, or abbreviations)

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Measurement GRADE: 7

Objective

The student can apply measurement concepts.

Suggested Measurement Strategy

Answering questions about measurement. These questions may require selecting an appropriate measurement unit or measuring device; estimating or measuring length, weight, volume, or temperature in metric or customary units; converting units within a measurement system; performing calculations with measured quantities; or interpreting scale drawings.

Subskills

The open circles O indicate subskills for you to consider in your instruction.

○ 1. Identifying Units of Measurement

The student can determine the appropriate type of measurement and select the appropriate units of measurement within a given measurement system.

○ 2. Estimation

The student can estimate measurable quantities within a given measurement system.

○ 3. Using Measuring Devices

The student can read and interpret information by using a measuring device within a given measurement system.

○ 4. Conversions and Operations

The student can make necessary conversions using units of measurement within a given measurement system and can perform calculations which may involve conversions.

○ 5. Scale Drawings

The student can read, interpret, and construct scale drawings within a given measurement system.

OBJECTIVE: Measurement GRADE: 7

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Interpretation of Pictured Measuring Devices

The student can "read" representations of the various measuring devices (for example, clocks, scales, rulers, thermometers, etc.).

○ 2. Comprehension of Measurement Situations

The student can analyze a situation described pictorially and/or verbally to determine, from the information given, what quantity or property is to be measured. This requires familiarity with the words used to describe measurable attributes (for example, "tall", "wide", "warm", "heavy", etc.).

○ 3. Knowledge of Measurement Units, Abbreviations, and Symbols

The student can recognize measurement units, symbols, and abbreviations and can associate each with a physical attribute it describes as well as a measurement device. For example, kilograms are a measure of weight determined by using a scale.

○ 4. Selection of Appropriate Measurement Units

The student can differentiate among the various units used to measure a particular attribute and recognize when each unit is most appropriate to use. For example, miles, not inches, are more appropriately used to measure long distances.

○ 5. Knowledge of Measurement Equivalents

The student knows measurement equivalents (for example, 12 inches = 1 foot, 60 seconds = 1 minute). This skill includes the ability to identify the larger/smaller unit of measure.

○ 6. Determination of Measurement Plausibility

The student is familiar with the physical properties of common objects and events so that the student can judge the reasonableness of estimations of those properties.

○ 7. Interpretation of Scaled Measurement

The student understands the concept of "scale distance" versus "actual distance" and can distinguish on a scale drawing between the units used to measure each.

ME-7.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 7
SUBSKILL: Identifying Units of Measurement

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement
SUBSKILL: Estimation

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 7
SUBSKILL: Using Measuring Devices

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 7
SUBSKILL: Conversions and Operations

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement
SUBSKILL: Scale Drawings
GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

ME-8.1

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Measurement GRADE: 8

Objective

The student can apply measurement concepts.

Suggested Measurement Strategy

Answering questions about measurement. These questions may require selecting an appropriate measurement unit or measuring device; estimating or measuring length, weight, volume, or temperature in metric or customary units; converting units within a measurement system; performing calculations with measured quantities; or interpreting scale drawings.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

● 1. Identifying Units of Measurement

The student can determine the appropriate type of measurement and select the appropriate units of measurement within a given measurement system.

● 2. Estimation

The student can estimate measurable quantities within a given measurement system.

● 3. Using Measuring Devices

The student can read and interpret information by using a measuring device within a given measurement system.

● 4. Conversions and Operations

The student can make necessary conversions using units of measurement within a given measurement system and can perform calculations which may involve conversions.

● 5. Scale Drawings

The student can read, interpret, and construct scale drawings within a given measurement system.

OBJECTIVE: Measurement GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Interpretation of Pictured Measuring Devices

The student can "read" representations of the various measuring devices (for example, clocks, scales, rulers, thermometers, etc.).

○ 2. Comprehension of Measurement Situations

The student can analyze a situation described pictorially and/or verbally to determine, from the information given, what quantity or property is to be measured. This requires familiarity with the words used to describe measurable attributes (for example, "tall", "wide", "warm", "heavy", etc.).

○ 3. Knowledge of Measurement Units, Abbreviations, and Symbols

The student can recognize measurement units, symbols, and abbreviations and can associate each with a physical attribute it describes as well as a measurement device. For example, kilograms are a measure of weight determined by using a scale.

○ 4. Selection of Appropriate Measurement Units

The student can differentiate among the various units used to measure a particular attribute and recognize when each unit is most appropriate to use. For example, miles, not inches, are more appropriately used to measure long distances.

○ 5. Knowledge of Measurement Equivalents

The student knows measurement equivalents (for example, 12 inches = 1 foot, 60 seconds = 1 minute). This skill includes the ability to identify the larger/smaller unit of measure.

○ 6. Determination of Measurement Plausibility

The student is familiar with the physical properties of common objects and events so that the student can judge the reasonableness of estimations of those properties.

○ 7. Interpretation of Scaled Measurement

The student understands the concept of "scale distance" versus "actual distance" and can distinguish on a scale drawing between the units used to measure each.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Identifying Units of Measurement

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)

In what units would the length of an airplane be given?

(A) millimeters

(B) cubic inches

(C) square feet

(D) meters (correct)

Write Your Own Item

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement
SUBSKILL: Estimation
GRADE: 8

Sample Item and Directions

(Teacher reads.)

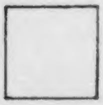
Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)



Estimate the area of this square.

(A) 1 square inch

(B) 2 square inches

(C) $\frac{1}{2}$ square inch

(D) $\frac{1}{4}$ square inch (correct)

Write Your Own Item

Use the back of this page.

ME-8.4

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Using Measuring Devices

Sample Item and Directions

(Teacher reads.)

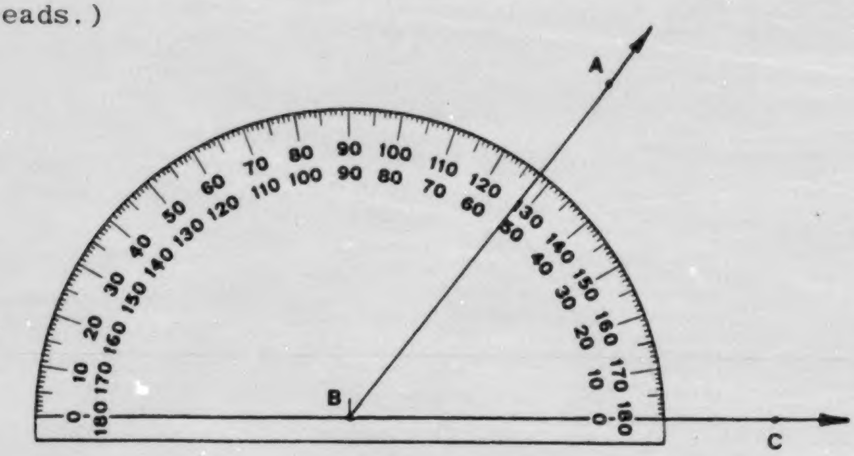
Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)



What is the measure of ∠ ABC?

(A) 38°

(B) 52° (correct)

(C) 68°

(D) 128°

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Conversions and Operations

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

9 ft. 7 in.
+ 9 in.

(A) 9 ft. 16 in.

(B) 10 ft. 0 in.

(C) 10 ft. 4 in. (correct)

(D) 10 ft. 6 in.

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Scale Drawings

Sample Item and Directions

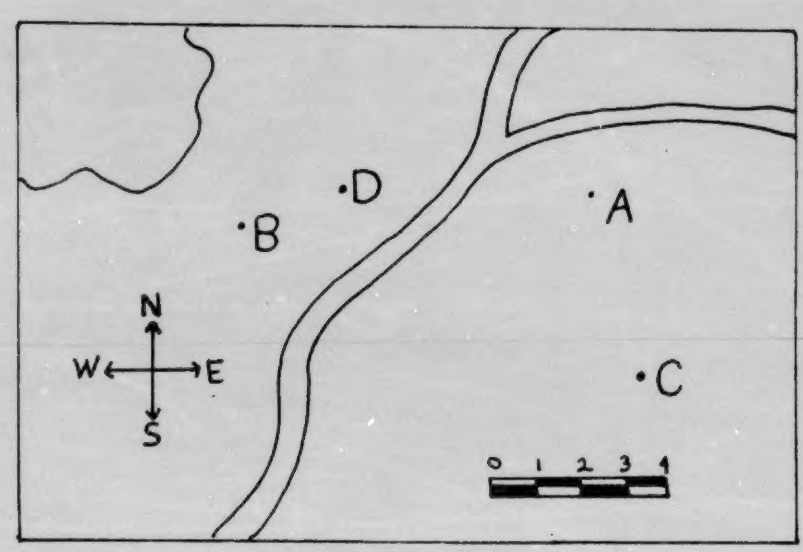
(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)



What is the approximate distance between point A and point B?

(A) 8 mi. (correct)

(B) 12 mi.

(C) 4 mi.

(D) 2 mi.

Write Your Own Item
Use the back of this page.

Geometry

TABLE OF CONTENTS

GRADE: All

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TEACHING OUR SKILLS

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GE-0.2

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Geometry GRADE: All

Objective

The student can apply geometric concepts.

Explanation

This objective includes skills that enable students to directly relate their mathematical learning to the world around them. Students learn to identify geometric figures such as points, lines, planes, and angles through the use of their properties. In nature, examples of these figures (e.g., the spiral shell or spider web) and their properties (symmetry of bi-valve shell or butterfly) can be found. Finding perimeters, areas, and volumes of geometric figures is an important skill in itself and is also one needed in many problem-solving situations.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identification The student can identify geometric representations through the use of their properties.	●	●	●	O	O	●	O	●	O	O	●	O
2. Comparison The student can compare geometric representations through the use of their properties.	●	●	●	O	O	O	O	●	O	O	●	O
3. Application The student can apply geometric concepts to determine the perimeter area, or volume of geometric representations.				O	O	●	O	●	O	O	●	O

OBJECTIVE: Geometry GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Knowledge of Geometric Properties The student is familiar with the specific properties of each geometric figure, construction, and representation.	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Geometric Vocabulary The student can read the name of each geometric figure, construction, and representation.	O	O	O	O	O	O	O	O	O	O	O	O
3. Comprehension of Comparative Vocabulary The student understands the terminology used to indicate geometric comparisons. This vocabulary includes "smallest", "largest", "same size", "same shape", "congruent", and "similar".	O	O	O	O	O	O	O	O	O	O	O	O
4. Recognition of Symmetry The student can visualize whether a figure is divided symmetrically.			O	O	O	O	O	O	O	O	O	O
5. Knowledge of Specific Formulas The student knows the formulas for perimeter, circumference, area, and volume for geometric figures.						O	O	O	O	O	O	O
6. Labeling The student can label geometric representations.						O	O	O	O	O	O	O

TEACHING OUR SKILLS
WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Geometry GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Identification	
2. Comparison	
3. Application	

GE-0.4

ACTIVITY: Sorting and Matching GRADE: Early

Purpose: To help students learn basic geometric concepts.

Materials: Set of Blocks

Obtain a set of blocks having varying characteristics: different colors, sizes, and/or shapes.

Directions:

Use the blocks for activities like those that follow.

1. Students can be asked to sort the blocks according to size, shape, number of sides, number of concerns, etc. The blocks can also be compared using the terms largest, smallest, same size, and same shape.
2. Students can prepare cutouts of geometric figures, then match those cutouts on many of the same dimensions as those described in step #1 above. The terms "congruent" and "similar" might also be introduced and used in sorting the cutouts.
3. Cards with a different shape drawn in each square can be made. One student holds up a block or a cutout and the others use a marker to cover that shape on their cards.

Example:

△	▲	○
■	□	△
▭	●	□

ACTIVITY: Drawing with Geometry GRADE: Early

Purpose: To aid in students' understanding of geometric designs and pictures

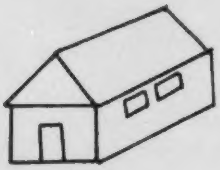
Materials: Chalkboard

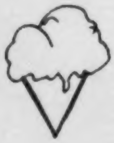
Draw one or more geometric figures on the chalkboard.

Directions:

1. Have students copy the figures on paper, then create a drawing using them. Drawings can be shared when they are completed.

   Examples:





2. As a variation, ask student to look carefully at a picture, and then list the names of all the geometric figures they can recognize in that picture.

ACTIVITY: Symmetry GRADE: Early

Purpose: To help students understand the concept of symmetry

Materials: Geometric Figure Cut-Outs

Draw some geometric figures on a sheet of paper. Draw dotted fold-lines on some figures. Omit fold-lines on others. Include figures with more than one line of symmetry, others with no lines of symmetry, and some symmetric about a point.

Directions:

1. For figures with fold-lines, ask students to predict whether the folded sides will match. Then have them verify their guess by actually folding the figures.

2. For figures with fold-lines omitted, ask the students to experiment with finding them.

3. As a variation, give students lines of symmetry to work with and have them draw figures that fit those lines. Encourage students to prepare drawings based on a wide variety of figures, not just the regular geometric figures they have been studying.

ACTIVITY: Who Am I? GRADE: Early

Purpose: To provide practice in learning geometric properties

Materials: None

Directions:

1. Begin by illustrating a "Who Am I?" riddle for students. Base the riddle on the properties of figures that have been studied in class. For example, say:

   "I have four sides.
   All of my sides are equal.
   Who am I?"

2. Once students become familiar with the riddle format, let them take turns preparing riddles for their classmates.

3. Students might be required to respond by drawing their answers, then labeling the drawing with its geometric name.

GE-0.7

ACTIVITY: Can You Find It? GRADE: Early

Purpose: To familiarize students with the properties of geometric figures

Materials: Colored Markers or Crayons and Paper

Prepare sheets with the name of a single geometric figure at the top of each sheet (for example, closed curve, rectangle, etc.).

Directions:

1. Divide the class into teams and assign each team a different color marker or crayon with which to record its findings.
2. Give one sheet containing the name of a geometric figure to each team. Team members are to go around the room looking for as many examples of the figure listed on their sheet as they can find. They should record on their sheet the name of each object they find, using their assigned color.
3. After a specified time period, teams exchange their sheets. Now, the new team reads over what the first team did, then tries to add more examples to that list in the new team's color. Names of objects may not be repeated.
4. Continue exchanging sheets until all teams have had a chance to work on each one. At the end of the activity, the entries on each list should be verified for accuracy. After this verification, the winning team is determined by totaling up the different-colored entries to see which team recorded the most entries.

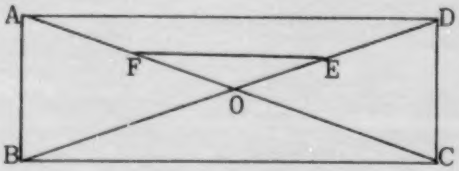
ACTIVITY: Geometric Matching GRADE: Later

Purpose: To promote learning of concepts of congruency and similarity

Materials: Worksheets with Geometric Diagrams.

Prepare a series of worksheets displaying geometric diagrams of increasing complexity. Under each diagram provide a column headed "Congruent" and a column headed "Similar".

Example:



Congruent Similar

Make enough copies for your class.

Directions:

1. Distribute worksheets to students.
2. Ask students to identify all pairs of congruent figures and all pairs of similar figures, then list them in the appropriate columns.

Example:

Congruent	Similar
ABC ≅ DCB	EOF ∼ BOC
AOB ≅ DOC	EOF ∼ DOA
ABD ≅ DCA	
AOD ≅ COB	

3. When students have found all of the possible congruent and similar matches on one diagram, they should progress to the next, more difficult, diagram.
4. The class can be stopped after a pre-specified period of time and asked to identify all matches made. The student with the most number of correct matches wins.
5. Or, the class can be asked to stop after each drawing is examined, so that matches can be discussed.

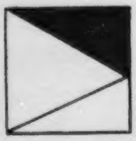
ACTIVITY: Area Investigations **GRADE:** Later

Purpose: To promote an intuitive understanding of the relationships between area formulas for various figures

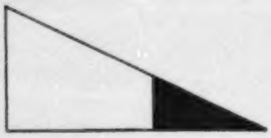
Materials: Paper, Scissors, Narrow Strips of Cardboard

Directions:

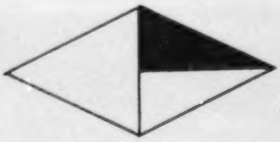
1. Have students prepare cutout geometric figures, then arrange those figures in various ways.



Square



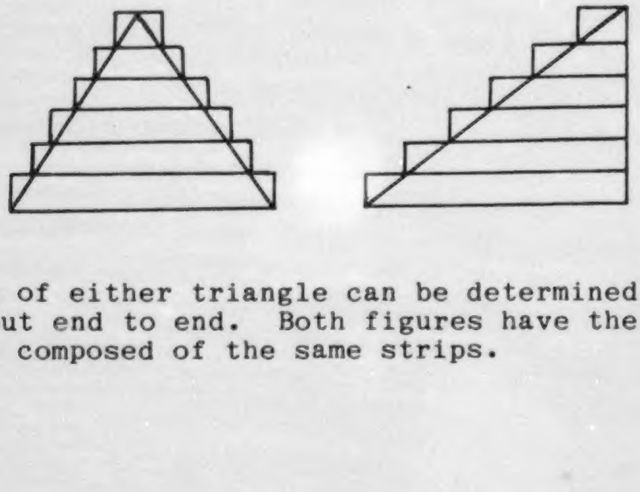
Triangle



Parallelogram

2. Have students measure the dimensions of each figure arrangement, and, then use formulas to compute each figure's area. Students can verify that the areas are the same for each arrangement regardless of the figure placement.

3. To show that the area of a triangle or a parallelogram does not change if the altitude and base are fixed, have students cut narrow strips of cardboard (1 inch wide) to approximate the area of each figure. The strips are arranged into figures similar to those below:



The area of either triangle can be determined by laying the strips out end to end. Both figures have the same area since they are composed of the same strips.

ACTIVITY: Formula Follies **GRADE:** Later

Purpose: To promote learning of formulas for perimeter, area, and volume

Materials: A List of Formulas and Answer Keys

Make a list of formulas students are currently studying.

Directions:

1. Distribute formula lists to each student.
2. Instruct students to make up word problems that can be solved by using the formulas listed. These problems may be silly ones, if desired.

   Example: "George, the grape-colored giant, wanted to plant a vegetable garden with equal-sized plots for three crops. He decided to make each plot 10 miles long on each side. How much area does his vegetable garden cover?"

3. Have students also prepare an answer key for their problems. The answer keys should indicate the formula to be used for each problem as well as the problem's solution.
4. Problems can be exchanged and worked by other students, then checked against the answer key.

ACTIVITY: Geometric Constructions GRADE: Later

Purpose: To provide practice in using measurement and geometric skills

Materials: Rulers, Compasses, and Protractors

Directions:

1. Supply students with rulers, compasses, and protractors. Then give them written or oral directions to construct specified figures. (For example, draw an equilateral triangle with sides 5 inches long.) The directions given can be simple or complex, depending upon the level of the class. Students might enjoy preparing sets of directions to present as challenges to the rest of the class. Have students label all parts of their drawings.
2. In order to practice the identification of coordinates, give students graph paper. Ask students to mark off a specified space, then direct students to locate and label a set of points [for example, R is located at the point (2, 4)].

ACTIVITY: Which One is Wrong? GRADE: Later

Purpose: To promote learning of geometric properties through geometric drawings

Materials: Set of Geometric Drawings

Prepare and label a set of geometric drawings. These drawings should cover all the figures, constructions, and representations students have studied. Each drawing should misrepresent one property of the specified figure, construction, or representation. (For example, a right triangle may lack a right angle.) Make enough copies for your class.

Directions:

1. Distribute copies to students.
2. On their copies, have students indicate the error in each drawing and correct the error.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Geometry GRADE: All

Test Item Description: Overview

For Geometry, the student must select or apply a geometric concept in order to identify or compare geometric representations and figures. The student may also be required to use formulas for determining areas, perimeters, and volumes of geometric representations. Formulas may or may not be given.

As grade level increases, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, NATURE OF PROBLEM and TYPE OF FIGURES/TERMS).

1. Identification - The student should identify or select the correct figure, term, or label. The types of figures and terms eligible for testing increase in number as grade levels increase. In the later grades, students should be able to use labeling to identify figures.
2. Comparison - The student should be able to compare geometric representations based on size and shape and should understand the concepts of symmetry, congruence, and similarity. The types of figures eligible for testing begin with common objects/shapes and expand to include segments and angles.
3. Application - In the later grades, the student should be able to use formulas in determining the area, perimeter, or volume of geometric figures. The eligible formulas and figures increase as grade levels increase.

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
APPLICATION	NATURE OF PROBLEM	Not tested	Not tested	Not tested			Using formulas for area, perimeter, or volume See Content Supplement, Formulas, Grade 6.		Using formulas for area, perimeter, or volume See Content Supplement, Formulas, Grade 8.	
	TYPES OF FIGURES						Rectangle or square		Perimeter: circles or polygons Area: triangles, circles, or parallelograms Volume: rectangular prisms	
	TYPES OF NUMBERS						Whole numbers		Whole numbers	
	MEASUREMENT UNITS ALLOWED?						Inches, centimeters, feet, meters, or yards		Inches, centimeters, feet, meters, or yards	

*Refer to the Suggested Measurement Strategy for the State Objective.

GE-0.13

SKILL DIFFICULTY CHART

OBJECTIVE: Geometry GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADE 9-12*
IDENTIFICATION	NATURE OF PROBLEM	Identify the figure that goes with the given name.	Identify the name that goes with the figure shown.	Identify the name that goes with the figure shown.			Choose the correct figure, term, or label.		Choose the correct figure, term, or label.	
	TYPES OF FIGURES/ TERMS	See Content Supplement, Figures and Terms, Grade 1.	See Content Supplement, Figures and Terms, Grades 1-2.	See Content Supplement, Figures and Terms, Grades 1-3.			See Content Supplement, Figures and Terms, Grades 1-6.		See Content Supplement, Figures and Terms, Grades 1-8.	
COMPARISON	NATURE OF PROBLEM	Identify the largest/ smallest figure	Identify congruent or similar figures	Determining a line of symmetry or image of a figure			Not tested		Identify congruent or similar figures	
	TYPES OF FIGURES	Geometric figures or shapes of common objects	Geometric figures or shapes of common objects	Geometric figures or shapes of common objects					A geometric diagram with measured segments/ angles	

*Refer to the Suggested Measurement Strategy for the State Objective.

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

GEOMETRIC FIGURES AND TERMS

OBJECTIVE: Geometry GRADE: 1-3

This supplement is cumulative in the sense that figures and terms at each grade should also be taught at subsequent grades.

Grade 1

- circles
- curves
  - closed
  - open
- rectangles
- squares
- triangles

Grade 2

(No additional figures/terms)

Grade 3

- angle
- line
- line segment
- point (inside, on, or outside a figure)
- ray

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

GEOMETRIC FIGURES AND TERMS

OBJECTIVE: Geometry GRADE: 4-6

This supplement is cumulative in the sense that figures and terms at each grade should also be taught at subsequent grades.

Grade 4

(Grade 1-3 figures/terms and other appropriate ones)

Grade 5

(Grade 1-4 figures/terms and other appropriate ones)

Grade 6

- angle
  - right
- circle
  - center
  - circumference
  - diameter
  - radius
- cone
- cube
- cylinder
- lines and line segments
  - diagonal
  - equal
  - intersecting
  - parallel
  - perpendicular
- parallelogram
- points
  - intersection
  - midpoint
  - vertex
- polygon
- ray
- rhombus
- sphere
- triangles
  - equilateral
  - isoceles
  - scalene

FORMULAS

OBJECTIVE: Geometry GRADE: 4-6

Grades 4 & 5

(Any appropriate formulas for these grades)

Grade 6

Perimeter

Rectangle: $P = 2l + 2w$

Square: $P = 4s$

Area

Rectangle: $A = l \times w$

Square: $A = s^2$

GE-0.16

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

GEOMETRIC FIGURES AND TERMS

OBJECTIVE: Geometry GRADE: 7 & 8

This supplement is cumulative in the sense that figures and terms at each grade should also be taught at subsequent grades.

Grade 7

(Grades 1-6 figures/terms and other appropriate ones)

Grade 8

- angles
  - acute
  - obtuse
  - straight
- bisector
  - angle bisector
  - line bisector
- coordinates of a point on a grid
- hexagon
- octagon
- pentagon
- quadrilateral
- trapezoid

FORMULAS

OBJECTIVE: Geometry GRADE: 7 & 8

Grade 7

(Grade 6 formulas and any other appropriate ones)

Grade 8

Perimeter

Polygon: $P = \text{sum of sides}$

Area

Circle: $A = \pi r^2$

Parallelogram: $A = b \times h$

Rectangle: $A = l \times w$

Square: $A = s^2$

Triangle: $A = \frac{1}{2}b \times h$

Volume

Rectangular Prism: $V = l \times b \times h$

GE-7.1

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Geometry GRADE: 7

Objective

The student can apply geometric concepts.

Suggested Measurement Strategy

Answering questions about geometric representations. These questions may require identifying or comparing geometric figures, identifying properties of geometric figures, or determining the perimeters, areas, or volume of geometric figures.

Subskills

The open circles O indicate subskills for you to consider in your instruction.

○ 1. Identification

The student can identify geometric representations through the use of their properties.

○ 2. Comparison

The student can compare geometric representations through the use of their properties.

○ 3. Application

The student can apply geometric concepts to determine the perimeter area, or volume of geometric representations.

OBJECTIVE: Geometry GRADE: 7

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Geometric Properties

The student is familiar with the specific properties of each geometric figure, construction, and representation.

○ 2. Comprehension of Geometric Vocabulary

The student can read the name of each geometric figure, construction, and representation eligible for testing.

○ 3. Comprehension of Comparative Vocabulary

The student understands the terminology used to indicate geometric comparisons. This vocabulary includes "smallest", "largest", "same size", same shape", "congruent", and "similar".

○ 4. Recognition of Symmetry

The student can visualize whether a figure is divided symmetrically.

○ 5. Knowledge of Specific Formulas

The student knows the formulas for perimeter, circumference, area, and volume for geometric figures.

○ 6. Labeling

The student can label geometric representations.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Geometry
SUBSKILL: Identification

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Geometry
SUBSKILL: Comparison

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

HOW SKILLS ARE TESTED

OBJECTIVE: Geometry
SUBSKILL: Application

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Geometry GRADE: 8

Objective

The student can apply geometric concepts.

Suggested Measurement Strategy

Answering questions about geometric representations. These questions may require identifying or comparing or contrasting geometric figures, identifying properties of geometric figures, or determining the perimeters, areas, or volumes of geometric figures.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

● 1. Identification

The student can identify geometric representations through the use of their properties.

● 2. Comparison

The student can compare geometric representations through the use of their properties.

● 3. Application

The student can apply geometric concepts to determine the perimeter area, or volume of geometric representations.

OBJECTIVE: Geometry GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Geometric Properties

The student is familiar with the specific properties of each geometric figure, construction, and representation.

○ 2. Comprehension of Geometric Vocabulary

The student can read the name of each geometric figure, construction, and representation eligible for testing.

○ 3. Comprehension of Comparative Vocabulary

The student understands the terminology used to indicate geometric comparisons. This vocabulary includes "smallest", "largest", "same size", same shape", "congruent", and "similar".

○ 4. Recognition of Symmetry

The student can visualize whether a figure is divided symmetrically.

○ 5. Knowledge of Specific Formulas

The student knows the formulas for perimeter, circumference, area, and volume for geometric figures.

○ 6. Labeling

The student can label geometric representations.

GE-8.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Geometry GRADE: 8
SUBSKILL: Identification

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

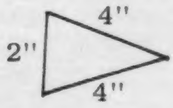
(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

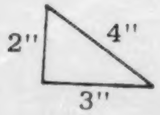
(Student reads.)

Which figure is a scalene triangle?

(A)

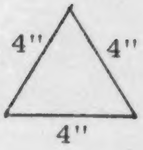


(B)

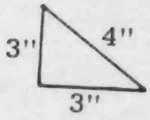


(correct)

(C)



(D)



Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Geometry GRADE: 8
SUBSKILL: Comparison

Sample Item and Directions

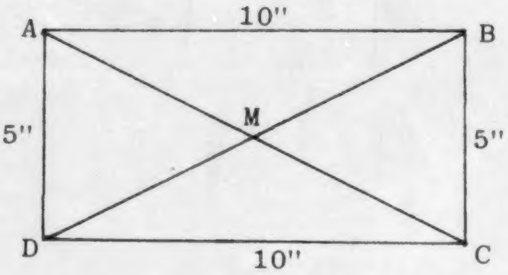
(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)



Which triangle is congruent to △ ABC?

(A) △ DMC

(B) △ BMA

(C) △ CDA (correct)

(D) △ BMC

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Geometry
SUBSKILL: Application

GRADE: 8

Sample Item and Directions

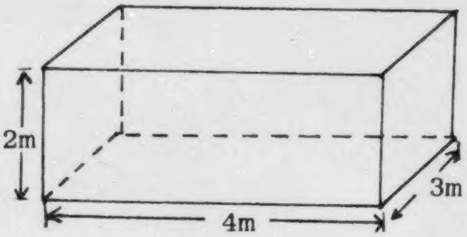
(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)



The volume of the box above is?

(A) 8 cubic meters

(B) 9 cubic meters

(C) 12 cubic meters

(D) 24 cubic meters (correct)

Write Your Own Item
Use the back of this page.

Problem Solving

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TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Problem Solving GRADE: All

Objective

The student can solve problems involving the use of mathematics.

Explanation

Problem solving represents a high order intellectual skill which is central to mathematics, to other subject areas, and to applied areas. The objective requires the use of previously-acquired conceptual, operational, measurement, and geometric skills. There is no single strategy for coming up with a solution to a problem. Consider a problem such as: "If all men wear pants and I wear pants, am I a man?". A student may be able to "see" the solution immediately with no planned strategy at all. Another student may need to apply principles of logic. Thus, problem-solving is a skill that relies heavily on previous knowledge and allows students creativity in devising solution strategies.

Subskills: Overview

This objective is not broken down into subskills for testing purposes. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally. The symbol ● indicates that the skill is tested.

OBJECTIVE	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
The student can solve problems involving the use of mathematics.	●	●	●	O	O	●	O	●	O	O	●	O

Problem solving may necessitate that students do the following:

1. Analyze the problem situation. - The student must carefully read and comprehend the conditions set forth in the problem.
2. Make decisions. - Once the student has identified key elements of the problem situation, the student must make certain decisions (for example, what is to be solved for or which data to use).
3. Devise a plan. - The student may need to devise a strategy for solving the problem.
4. Judge the feasibility of the solution. After the student has determined his solution to the problem, he should judge whether: (a) his answer answers the question; (b) the answer is reasonable; and (c) the answer has the correct label. Then, the student must be able to, if necessary, defend his work.

Some problems requiring unusual solutions do not fit the pattern above. Teachers are encouraged to include from time to time such problems as brain teasers, "thought problems", etc, in their instructional programs.

OBJECTIVE: Problem Solving GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Comprehension of Problem The student must be able to understand the vocabulary used in the problem. In BSAP, the vocabulary is kept at a low level for problem solving to minimize reading difficulty.	O	O	O	O	O	O	O	O	O	O	O	O
2. Distinguishing Between Necessary and Unnecessary Data The student must be able to select the data necessary for solving the problem, omitting unnecessary data.	O	O	O	O	O	O	O	O	O	O	O	O
3. Interpreting Graphs, Tables, Charts, and Scale Drawings The student must be able to read and interpret graphs, tables, charts, and scale drawings and be able to select data necessary for solving the problem.					O	O	O	O	O	O	O	O
4. Operations The student must be able to select the appropriate operations for solving the problem, perform them in a sequence that will result in a correct solution, and accurately carry out the necessary computations.	O	O	O	O	O	O	O	O	O	O	O	O
5. Knowledge of Measurement Units, Abbreviations, and Conversions The student must be able to use measurement units and make any necessary conversions for arriving at the problem solution.					O	O	O	O	O	O	O	O
6. Use of Formulas The student must be able to use arithmetic and geometric formulas to arrive at the problem solution.					O	O	O	O	O	O	O	O
7. Estimation The student must be able to estimate needed data from tables and charts and measures of attributes of geometric configurations. Furthermore, the student may be required to estimate to assess the feasibility of solutions.					O	O	O	O	O	O	O	O

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TEACHING OUR SKILLS
WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Problem Solving GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Objective	Resource Material
Problem Solving	

ACTIVITY: Story Time GRADE: Early

Purpose: To provide practice in problem solving through story-telling

Materials: A Mathematical Sentence

Write a mathematical sentence on the board or make enough copies for your class. For example: 2 + 5 = 7 or open sentence examples: 16 - ______ = 8.

Directions:

1. Distribute a mathematical sentence to the students.
2. Ask individual students or the class as a whole to make up a story to go along with that sentence. Students may enjoy creating as many different situations as they can for each sentence, being as imaginative as possible.
3. Share the story problems with another class or use them at another time as practice problems to be solved.

ACTIVITY: Drawing It Out GRADE: Early

Purpose: To promote learning in translating words into mathematical expressions

Materials: Sheets of Paper and a Selected Word Problem

Directions:

1. Begin with a sheet of blank paper divided into "story frames" or squares.
2. Read aloud the first part of the problem and let students complete the first frame of their story. For example, if the first sentence in a problem states, "Jim won ten ballons," then the first frame in the story might show a person with ten balloons.
3. Continue with the rest of the problem in sequence, first reading a part and then allowing students to draw that part.
4. When students have completed one or more teacher-guided story boards, they may enjoy some of their own. Let students devise their own problems and illustrate them. Then story boards could be exchanged and other students asked to compose the verbal problem that they think corresponds to the story board.

ACTIVITY: Acting It Out GRADE: Early

Purpose: To provide practice in problem-solving through oral presentation of problems

Materials: None

Directions:

1. Each group makes up a problem and then devises a way to dramatize that problem.
2. Each group in turn performs its problem for the others in the class.
3. The other students then solve the problem and compare their solutions with the solution previously prepared by the performing group.

ACTIVITY: Emergency! GRADE: Early

Purpose: To provide practice in solving actual problems and in approaching the various steps in the problem-solving process from several different perspectives

Materials: Incomplete "Emergency Problems"

Devise a variety of incomplete problems that need rescue efforts to make them complete. One kind of emergency situation involves problems that are missing their last sentence. Another kind of emergency involves answers that have lost their problem. Other problems can have lost their data (that is, generalized problems that need specific numbers added) and problems that have lost their explanations (that is, mathematical sentences that have lost their words). Make enough copies for each rescue team.

Directions:

1. Students can be organized into rescue teams. These teams might be medical teams or, perhaps, inter-galactic space teams sent out to rescue stranded space travelers.

2. Have each rescue team complete the problems that you have devised.

    a. For problems missing their last sentence, the rescue squad must find that sentence and then solve the entire problem to make sure their victim has been helped.

    b. For lost-answer problems, the rescue teams must organize a search party to locate their victims; that is, they must compose a problem that could result in the solution they have been given.

    c. For lost-data and lost-explanation problems, the rescue teams must search for the lost data and/or come up with explanations.

3. Let rescue teams compare their results to each problem type.

ACTIVITY: Difficulty Mountain GRADE: Later

Purpose: To help students in problem solving by monitoring difficulty levels of various problems

Materials: Large Poster Sheets

Directions:

1. Have students monitor the difficulty levels of various verbal problems assigned to the class during the course of a semester or an entire year. A problem's difficulty level equals the number of students who cannot solve the problem correctly.

2. Have the class construct a mountain of increasingly difficult problems.

3. At the end of the semester or the year, a clearly differentiated set of problems exists. Share these problems with another class as a challenging exercise for other students who want to demonstrate how high on the Difficulty Mountain they can climb.

ACTIVITY: To Tell the Truth GRADE: Later

Purpose: To help students use pictorial data to solve problems

Materials: Large Sheets of Paper

Directions:

1. Divide students into work groups.

2. Let each group survey the entire class on some topic or question.

    a. A group may decide to collect demographic information: for example, the number and ages of brother and sisters in each student's family, how far students live from school.

    b. Or a group may want to survey classmates' opinions with questions such as "What is your favorite food?".

3. Have each work group prepare some sort of visual display to depict the data they have collected. This display might be a table or chart or a graph of some type.

4. When the displays are completed have each group prepare several word problems that can be solved using its display.

5. Let other members of the class then solve these problems.

ACTIVITY: Easy to Hard GRADE: Later

Purpose: To help students realize that "hard numbers" don't necessarily mean a hard problem and to aid in attention to detail

Materials: Two Versions of a Verbal Problem

Prepare two versions of a verbal problem. For example, both versions describe the same situation and use the same words. Only the numerical data vary between version one and version two. The first version contains very simple numbers; the second version contains larger, more difficult numbers.

Directions:

1. Have students arrive at a solution strategy for solving the first version of a problem.
2. Have students check their answers.
3. Then have students apply that same strategy to the problem's second version.

ACTIVITY: Measurement GRADE: Later

Purpose: To help students apply measurement concepts to problem-solving

Materials: Different Measuring Devices

Supply students with access to as many different measuring devices as possible (for example, clocks, rulers, thermometers, measuring cups).

Directions:

1. Have each student take one or more measurements with the device he or she has, and then devise problems using those measurements.
2. After each student has had a chance to work with each measuring device, let students exchange the problems that they have written.

ACTIVITY: Tournament of Champions GRADE: Later

Purpose: To practice problem-solving sklls in other than a pencil and paper exercise format

Materials: Card Sets containing Word Problems

Make a card deck consisting of one word problem on each card.

Directions:

1. Divide the class into three teams.
2. In preparation for competing in the tournament, allow each team time to practice separately with a set of cards containing word problems.
3. After the teams feel adequately prepared, begin the tournament.
    a. Three players, one from each team, compete against each other.
    b. A set of cards, with similar problems to those used during the practice sessions, is placed face down in the front of the three players.
    c. The first player turns over the top card and reads the problem aloud.
    d. Each player works out an answer.
    e. The first player offers a solution.
    f. If the solution is correct, that player keeps the card as a scoring token. If the solution is incorrect, the first opponent to challenge the answer and have the correct solution wins the scoring token.
4. After the first three players have completed their problems, let three new players come up to compete.
5. Continue play until all students have had at least one opportunity to play.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving GRADE: All

[illegible]t Item Description: Overview

For Problem Solving, the student is presented with a word problem. The student must be able to use computational skills and apply arithmetic, measurement, and geometric concepts to determine the solution.

As grade levels increase, the test questions become more difficult. The difficulty is controlled by the use of SKILL KEYS presented in the following chart (for example, PROBLEM TYPES and READABILITY).

A primary skill consideration is the method of obtaining the data necessary for solving the problem. In the earlier grades, students are required only to obtain data from the verbal problem. In later grades, the student may need to use data from a pictorial display (such as a chart, table, or graph) for solving the problem.

Another important consideration is the inclusion of data in a word problem that is not needed for arriving at the solution. Students should be able to determine what data is needed for the solution. Beginning with Grade 3, unneeded or unnecessary data may be present in the problem text.

A final consideration is the number of operations required in order to solve the problem which increases as grade levels increase.

In later grades, the student should be able to determine the exact, as well as the estimated, problem solution.

SKILL KEYS that are not central to the problem solving skill are minimized, for example, the reading difficulty, the types of numbers, the difficulty of performing operations, and the eligible measurement units.

SKILL DIFFICULTY CHART

OBJECTIVE: Problem Solving GRADE: All

OBJ.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4*	GRADE 5*	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12*
PROBLEM SOLVING	PROBLEM TYPES	Arithmetic	Arithmetic	Arithmetic, measurement			Arithmetic, measurement, geometry		Arithmetic, measurement, geometry	
	READ-ABILITY**	See chart page M-0. 5, Grade 1.	See chart page M-0. 5, Grade 2.	See chart page M-0. 5, Grade 3.			See chart page M-0. 5, Grade 6.		See chart page M-0. 5, Grade 8.	
	METHOD OF OBTAINING DATA	Verbal text	Verbal text	Verbal text			Verbal text, pictorial display		Verbal text, pictorial display	
	UNNECESSARY DATA	Not allowed	Not allowed	Not allowed			Allowed		Allowed	
	TYPES OF NUMBERS**	Whole numbers	Whole numbers	Whole numbers			Whole numbers, fractions, mixed numbers, decimals		Whole numbers, fractions, mixed numbers, decimals, percentages	
	NUMBER OF OPERATIONS	1	1	1-2			1-2		1-3	
	TYPES OF OPERATIONS REQUIRED**	Addition, subtraction	Addition, subtraction	Addition, subtraction, multiplication			Addition, subtraction, multiplication, division		Addition, subtraction, multiplication division	
	OPERATION DIFFICULTY**	No regrouping	No regrouping	Regrouping, direct measurement conversions only			Regrouping, reduction of fractions, measurement conversions		Regrouping, reduction of fractions, measurement conversions	
				See Measurement, Content Supplement, Units, Conversions, and Abbreviations, Grade 3.			See Measurement, Content Supplement, Units, Conversions, and Abbreviations, Grade 3.		See Measurement, Content Supplement, Units, Conversions, and Abbreviations, Grade 6.	
	TYPE OF PROBLEM SOLUTION	Exact	Exact	Exact			Exact, estimated		Exact, estimated	

*Refer to the Suggested Measurement Strategy for the State Objective.
**These factors are kept at a very low level at each grade.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Problem Solving GRADE: 7

Objective

The student can solve problems requiring the use of mathematics.

Suggested Measurement Strategy

Determining the solutions to verbal and nonverbal problems. These problems may require performing one or more mathematical operations with whole numbers, fractions, mixed numbers, decimals, percents, or measurement units. The problems may also require applying a formula and/or using information presented graphically. Decision-making and alternative solution strategies may be required. Problems will focus on situations familiar to students.

OBJECTIVE: Problem Solving GRADE: 7

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Problem

The student must be able to understand the vocabulary used in the problem. In BSAP, the vocabulary is kept at a low level for problem solving to minimize reading difficulty.

○ 2. Distinguishing Between Necessary and Unnecessary Data

The student must be able to select the data necessary for solving the problem, omitting unnecessary data.

○ 3. Interpreting Graphs, Tables, Charts, and Scale Drawings

The student must be able to read and interpret graphs, tables, charts, and scale drawings and be able to select data necessary for solving the problem.

○ 4. Operations

The student must be able to select the appropriate operations for solving the problem, perform them in a sequence that will result in a correct solution, and accurately carry out the necessary computations.

○ 5. Knowledge of Measurement Units, Abbreviations, and Conversions

The student must be able to use measurement units and make any necessary conversions for arriving at the problem solution.

○ 6. Use of Formulas

The student must be able to use arithmetic and geometric formulas to arrive at the problem solution.

○ 7. Estimation

The student must know how to round numbers for estimating the problem solution.

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TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving

GRADE: 7

Sample Item and Directions

Not applicable.

Write Your Own Item

Use the other sample items, the Skill Difficulty Chart, and the Suggested Measurement Strategy for this objective to write your own item.

Write your own item here.

TEACHING OUR SKILLS

WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Problem Solving GRADE: 8

Objective

The student can solve problems requiring the use of mathematics.

Suggested Measurement Strategy

Determining the solutions to verbal and nonverbal problems. These problems may require performing one or more mathematical operations with whole numbers, fractions, mixed numbers, decimals, percents, or measurement units. The problems may also require applying a formula and/or using information presented graphically. Decision-making and alternative solution strategies may be required. Problems will focus on situations familiar to students.

OBJECTIVE: Problem Solving GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Problem

The student must be able to understand the vocabulary used in the problem. In BSAP, the vocabulary is kept at a low level for problem solving to minimize reading difficulty.

○ 2. Distinguishing Between Necessary and Unnecessary Data

The student must be able to select the data necessary for solving the problem, omitting unnecessary data.

○ 3. Interpreting Graphs, Tables, Charts, and Scale Drawings

The student must be able to read and interpret graphs, tables, charts, and scale drawings and be able to select data necessary for solving the problem.

○ 4. Operations

The student must be able to select the appropriate operations for solving the problem, perform them in a sequence that will result in a correct solution, and accurately carry out the necessary computations.

○ 5. Knowledge of Measurement Units, Abbreviations, and Conversions

The student must be able to use measurement units and make any necessary conversions for arriving at the problem solution.

○ 6. Use of Formulas

The student must be able to use arithmetic and geometric formulas to arrive at the problem solution.

○ 7. Estimation

The student must know how to round numbers for estimating the problem solution.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving GRADE: 8

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

> TEEN MAGAZINE
>
> Posters of Movie Star Favorites
>
> Special Offer!
>
> Five Posters for $5.75
> Save $1.25 off the regular price!
>
> Send in Now! Don't be disappointed!
>
> Add $1.50 to your total purchase to cover postage and handling.

You decide to send away for the movie posters advertised above. You want to buy ten posters. How much money should you send in?

(A) $9.90

(B) $11.50

(C) $12.00

(D) $13.00 (correct)

Write Your Own Item
Use the back of this page.